

DIVISION 5

SURFACE TREATMENTS AND PAVEMENTS

5-01 CEMENT CONCRETE PAVEMENT REHABILITATION

5-01.1 Description

This Work consists of rehabilitating or replacing section(s) of Portland cement concrete pavement in accordance with these Specifications and in conformity with the lines, grades, thicknesses, and typical cross-sections shown in the Plans or established by the Engineer.

5-01.2 Materials

Materials shall meet the following requirements of the following sections:

Portland Cement	9-01
Fine Aggregate	9-03
Coarse Aggregate	9-03
Combined Aggregate	9-03
Joint Filler	9-04.1
Joint Sealants	9-04.2
Dowel Bars	9-07.5
Tie Bars	9-07.6
Concrete Patching Material	9-20
Curing Materials and Admixtures	9-23
Water	9-25
Epoxy Resins (bonding agents)	9-26

Parting Compound shall be a curing compound, grease or other substance approved by the Project Engineer.

Dowel Bar Retrofit

Dowel bar expansion caps shall be tight fitting and made of non-metallic material, which will allow for 1/4-inch of movement at each end of the bar.

Chairs for supporting the dowel bar shall be epoxy coated according to Section 9-07.3 or made from non-metallic material.

The foam insert shall be closed cell foam faced with poster board material or plastic faced material on each side commonly referred to as foam core board by office suppliers. The foam insert shall be capable of remaining in a vertical position and tight to all edges during the placement of the concrete patching material. Caulking filler used for sealing the transverse joint at the bottom and sides of the slot shall be a silicone caulk.

5-01.3 Construction Requirements

5-01.3(1) Vacant

5-01.3(1)A Concrete Mix Designs

The Contractor shall use either concrete patching materials or Portland cement concrete for the rehabilitation of cement concrete pavement. Concrete patching materials shall be used for spall repair and dowel bar retrofitting and may be used for concrete panel replacement; Portland cement concrete is only allowed for concrete panel replacement.

5-01.3(1)A1 Concrete Patching Materials

1. **Materials.** The prepackaged concrete patching material shall conform to Section 9-20. The aggregate extender shall conform to Section 9-03.1(4), AASHTO Grading No. 8.
2. **Submittals and Mix Approval.** The Contractor shall use the Manufacturer's recommended proportions for the mix design to be submitted to the Project Engineer for the concrete patching material. The Contractor's submittal shall include the mix proportions of the prepackaged concrete patching material, water, aggregate extender, and the proposed sources for all aggregates. If not approved for use on the QPL, submit test data indicating compliance with Section 9-20.

5-01.3(1)A2 Portland Cement Concrete

Portland cement concrete shall meet the requirements of Sections 5-05.3(1) and 5-05.3(2) and be air entrained with a design air content of 5.5-percent.

5-01.3(1)B Equipment

In addition to Sections 5-05.3(3)A, 5-05.3(3)B, 5-05.3(3)D and 5-05.3(3)E the following shall apply:

1. Mobile volumetric mixers shall be calibrated in accordance with Section 6-09.3(1)H. The references to the latex admixture shall not apply.
2. The equipment for grinding cement concrete pavement shall use diamond embedded saw blades gang mounted on a self propelled machine that is specifically designed to smooth and texture concrete pavement. The equipment shall not damage the underlying surface, cause fracture, or spalling of any joints.

5-01.3(2) Material Acceptance**5-01.3(2)A Concrete Patching Material**

Acceptance shall be based on field verification of the prepackaged patching material, and whether the amount of added water and aggregate extender complies with the mix design.

5-01.3(2)B Portland Cement Concrete

The point of acceptance will be at the discharge of the placement system.

The concrete producer shall provide a certificate of compliance for each truckload of concrete in accordance with Section 6-02.3(5)B.

Acceptance testing for compliance of air content and 28-day compressive strength shall be conducted from samples obtained according to FOP for WAQTC TM 2. Air content shall be determined by conducting WAQTC FOP for AASHTO T 152. Compressive Strength shall be determined by WSDOT FOP for AASHTO T 22 and WSDOT FOP for AASHTO T 23. The lower Specification limit for air content shall be 3-percent, and the upper Specification limit for air content shall be 7-percent. The lower Specification limit for compressive strength shall be 1,200-psi less than that established in the mix design as the arithmetic mean of the five sets of 28-day compressive strength cylinders, or 3,000-psi, whichever is higher. These compressive strength cylinders are to be cast at the same time as the flexural beams that were used to prequalify the mix design under Section 5-05.3(1). There is no upper Specification limit for 28-day compressive strength.

The Contractor shall provide cure boxes in accordance with Section 6-02.3(5)H, and protect concrete cylinders in cure boxes from excessive vibration and shock waves during the curing period in accordance with Section 6-02.3(6)D. Payment for cure boxes shall be in accordance with Section 6-02.5.

5-01.3(2)B1 Rejection of Concrete

Rejection by the Contractor: The Contractor may, prior to sampling, elect to remove any defective material and replace it with new material at no expense to the Contracting Agency. The replacement material will be sampled, tested and evaluated for acceptance.

Rejection without Testing: The Project Engineer may reject any load that appears defective prior to placement. Material rejected before placement shall not be incorporated into the pavement. No payment will be made for the rejected materials unless the Contractor requests that the rejected material be tested. If the Contractor elects to have the rejected materials tested, a sample will be taken and both the air content and strength shall be tested by WSDOT.

Payment for rejected material will be based on the results of the one sample, which was taken and tested. If the rejected material fails either test, no payment will be made for the rejected material and in addition, the cost of sampling and testing, at the rate of \$250.00 per sample shall be borne by the Contractor. If the rejected material passes both tests the mix will be compensated for at actual invoice cost and the cost of the sampling and testing will borne by the Contracting Agency.

5-01.3(3) Vacant

5-01.3(4) Replace Portland Cement Concrete Panel

Curing, cold weather Work, concrete pavement construction in adjacent lanes, and protection of pavement shall meet the requirements of Section 5-05.3(13) through Section 5-05.3(15).

Concrete slabs to be replaced as shown in the Plans or staked by the Project Engineer shall be at least 6.0-feet long and full width of an existing pavement panel. The portion of the panel to remain in place shall have a minimum dimension of 6-feet in length and full panel width; otherwise the entire panel shall be removed and replaced. There shall be no new joints closer than 3.0-feet to an existing transverse joint or crack. A vertical full depth saw cut is required along all longitudinal joints and at transverse locations and, unless the Engineer approves otherwise, an additional vertical full depth relief saw cut located 12-inches to 18-inches from and parallel to the initial longitudinal and transverse saw cut locations is also required. Removal of existing cement concrete pavement shall not cause damage to adjacent slabs that are to remain in place. The Contractor, at no cost to the Contracting Agency, shall repair any damage caused by the Contractor's operation. In areas that will be ground, slab replacements shall be performed prior to pavement grinding.

When new concrete pavement is to be placed against existing cement concrete pavement, tie bars and dowel bars shall be drilled and grouted into the existing pavement with either Type I or IV epoxy resin as specified in Section 9-26. Tie bars are not required for panel replacement less than a full panel.

Dowel bars shall be placed at the mid depth of the concrete slab, centered over the transverse joint, and parallel to the centerline and to the Roadway surface.

Placement tolerances for dowel bars

1. \pm 1-inch of the middle of the concrete slab depth.
2. \pm 1-inch of being centered over the transverse joint.
3. \pm 1/2-inch from parallel to the centerline.
4. \pm 1/2-inch from parallel to the Roadway surface.

Dowel bars may be adjusted to avoid contact with existing dowel bars in the transverse joint at approach slabs or existing panels without exceeding specified tolerances.

Tie bars shall be placed at the mid depth of the concrete slab, centered over the joint, perpendicular to centerline, and parallel to the Roadway surface.

Placement tolerances for tie bars

1. ± 1 -inch of the middle of the concrete slab depth.
2. ± 1 -inch of being centered over the joint.
3. ± 1 -inch from perpendicular to the centerline.
4. ± 1 -inch from parallel to the Roadway surface.

The horizontal position of tie bars may be adjusted to avoid contact with existing tie bars in the longitudinal joint where panel replacement takes place.

Dowel bars and tie bars shall be placed according to the Standard Plan when multiple panels are placed.

Panels shall be poured separately from the bridge approach slab.

Dowel bars to be drilled into existing concrete or at a new transverse contraction joint shall have a parting compound, such as curing compound, grease, or other Project Engineer approved equal, applied to them prior to placement.

The tie bar and dowel bar holes shall be blown clean with compressed air before grouting. The bar shall be centered in the hole for the full length of embedment before grouting. The grout shall then be pumped into the hole around the bar in a manner that the back of the hole will be filled first. Blocking or shimming shall not impede the flow of the grout into the hole. Dams, if needed, shall be placed at the front of the holes to confine the grout. The dams shall permit the escape of air without leaking grout and shall not be removed until grout has cured in the hole.

The Contractor shall smooth the surfacing below the removed panel and compact it to the satisfaction of the Project Engineer. Crushed surfacing base course, or hot mix asphalt may be needed to bring the surfacing to grade prior to placing the new concrete.

If the material under the removed panel is uncompactable and the Project Engineer requires it, the Contractor shall excavate the Subgrade 2-feet, place a soil stabilization construction geotextile meeting the requirements of Section 9-33, and backfill with crushed surfacing base course. This Work may include:

1. Furnishing and hauling crushed surfacing base course to the project site.
2. Excavating uncompactable material.
3. Furnishing and placing a soil stabilization construction geotextile.
4. Backfilling and compacting crushed surfacing base course.
5. Removing, hauling and restocking any unused crushed surfacing base course.

Side forms shall meet the requirements of Section 5-05.3(7)B whenever a sawed full depth vertical face cannot be maintained.

The Contractor shall place a bond-breaking material such as polyethylene film, roofing paper, or other material as approved by the Engineer along all existing concrete surfaces and between the bottom of the slab and treated bases prior to placing concrete.

Grade control shall be the responsibility of the Contractor.

All panels shall be struck off level with the adjacent panels and floated to a smooth surface.

Final finish texturing shall meet the requirements of Section 5-05.3(11).

In areas where the Plans do not require grinding, the surface smoothness will be measured with a 10-foot straightedge by the Project Engineer in accordance with Section 5-05.3(12). If the replacement panel is located in an area that will be ground as part of portland cement concrete pavement grinding in accordance with Section 5-01.3(9), the surface smoothness shall be measured, by the Contractor, in conjunction with the smoothness measurement done in accordance with Section 5-01.3(10).

All transverse and longitudinal joints shall be sawed and sealed in accordance with Section 5-05.3(8). The Contractor may use a hand pushed single blade saw for sawing joints.

Opening to traffic shall meet the requirements of Section 5-05.3(17).

5-01.3(5) Partial Depth Spall Repair

Removal of the existing pavement shall not damage any pavement to be left in place. Any existing pavement that is to remain that has been damaged shall be repaired at the Contractor's expense. If jackhammers are used for removing pavement, they shall not weigh more than 30-pounds, and chipping hammers shall not weigh more than 15-pounds. All power driven hand tools used for the removal of pavement shall be operated at angles less than 45-degrees as measured from the surface of the pavement to the tool. The patch limits shall extend beyond the spalled area a minimum of 3.0-inches. Repair areas shall be kept square or rectangular. Repair areas that are within 12.0-inches of another repair area shall be combined.

A vertical saw cut shall be made to a minimum depth of 2.0-inches around the area to be patched as marked by the Project Engineer. The Contractor shall remove material within the perimeter of the saw cut to a depth of 2.0-inches, or to sound concrete as determined by the Project Engineer.

The surface patch area shall be sand blasted and all loose material removed. All sandblasting residue shall be removed using dry oil-free air.

Spall repair shall not be done in areas where dowel bars are encountered.

When a partial depth repair is placed directly against an adjacent longitudinal joint, a bond-breaking material such as polyethylene film, roofing paper, or other material as approved by the Engineer shall be placed between the existing concrete and the area to be patched.

Patches that abut working transverse joints or cracks require placement of a compressible insert. The new joint or crack shall be formed to the same width as the existing joint or crack. The compressible joint material shall be placed into the existing joint 1.0-inch below the depth of repair. The compressible insert shall extend at least 3.0-inches beyond each end of the patch boundaries.

Patches that abut the lane/Shoulder joint require placement of a formed edge, along the slab edge, even with the surface.

The patching material shall be mixed, placed, consolidated, finished and cured according to manufacturer's recommendations. Slab/patch interfaces that will not receive pavement grinding shall be sealed (painted) with a 1:1 cement-water grout along the patch perimeter.

The Contractor shall reseal all joints in accordance with Section 5-05.3(8)B.

Opening to traffic shall meet the requirements of Section 5-05.3(17).

5-01.3(6) Dowel Bar Retrofit

Dowel bars shall be installed in the existing concrete pavement joints and transverse cracks where shown in the Plans or as marked by the Project Engineer.

Saw cut slots will be required in the pavement to place the center of the dowel at mid-depth in the concrete slab. The completed slot shall provide a level, secure surface for the feet of the dowel bar chairs. Slots that intersect longitudinal or random cracks shall not be retrofitted. When gang saws are used, slots that are not used shall be cleaned and sealed with either Type I or IV epoxy resin as specified in Section 9-26. The transverse joint between Portland Cement Concrete Pavement and a Bridge approach slab shall not be retrofitted.

Saw cut slots shall be prepared such that dowel bars can be placed at the mid depth of the concrete slab, centered over the transverse joint, and parallel to the centerline and to the Roadway surface.

Placement tolerances for dowel bars

1. \pm 1-inch of the middle of the concrete slab depth.
2. \pm 1-inch of being centered over the transverse joint.
3. \pm 1/2-inch from parallel to the centerline.
4. \pm 1/2-inch from parallel to the Roadway surface.

If jackhammers are used to break loose the concrete they shall weigh less than 30-pounds.

All slot surfaces shall be cleaned to bare concrete by sand blasting. The cleaning shall remove all slurry, parting compound, and other foreign materials prior to installation of the dowel. Any damage to the concrete shall be repaired by the Contractor at no cost to the Contracting Agency. Traffic shall not be allowed on slots where concrete has been removed.

Prior to placement, the dowel bars shall be lightly coated with a parting compound and placed on a chair that will provide a minimum of 1/2-inch clearance between the bottom of the dowel and the bottom of the slot.

The chair design shall hold the dowel bar tightly in place during placement of the concrete patching material. Immediately prior to placement of the dowel bar and concrete patching material, the Contractor shall caulk the transverse joint or crack at the bottom and sides of the slot as shown in the Plans. The caulking filler shall not be placed any farther than 1/2-inch outside either side of the joint or crack. The transverse joint or crack shall be caulked sufficiently to satisfy the above requirements and to prevent any of the patching material from entering the joint/crack at the bottom or sides of the slot.

A 3/8-inch thick foam insert shall be placed at the middle of the dowel to maintain the transverse joint. The foam insert shall fit tightly around the dowel and to the bottom and edges of the slot and be a minimum of 1 1/2-inch below the existing concrete surface. The foam insert shall be capable of remaining in a vertical position and held tightly to all edges during placement of the patch. If for any reason the foam insert shifts during placement of the patch the Work shall be rejected and redone at the Contractor's expense.

Patching material shall be consolidated by using a 1.0-inch or less diameter vibrator as approved by the Project Engineer. The Contractor shall not overwork the patching material during the patch consolidation process.

The patching material on the surface of the dowel bar slots shall not be overworked, causing segregation and leaving the fine material on the surface. The patching material shall be left 1/8-inch to 1/4-inch high and not finished flush with the existing concrete surface.

The joint shall be maintained by saw cutting the surface with a hand pushed single blade saw. The cut width shall be $\frac{3}{16}$ to $\frac{5}{16}$ -inch and the depth $1\frac{1}{2}$ -inches. The cut length shall be $2\frac{1}{4}$ -feet long centered over the 3 retrofit dowel bars and shall be sawed within 24-hours after placement of the concrete patching material.

Opening to traffic shall meet the requirements of Section 5-05.3(17).

5-01.3(7) Sealing Existing Concrete Random Cracks

The Contractor shall route, clean and seal existing concrete random cracks where indicated by the Project Engineer. Cracks smaller than $\frac{3}{16}$ -inch in width shall be routed to $\frac{3}{16}$ -inch wide by 1-inch deep prior to placing the sealant. Cracks over $\frac{3}{16}$ -inch in width shall be cleaned and sealed.

All incompressible material shall be completely removed from the existing random crack to a depth of $\frac{3}{4}$ -inch. Immediately prior to sealing, the cracks shall be blown clean with dry, oil free compressed air.

The top surface of the sealant shall be at least $\frac{1}{4}$ -inch below the surface of the pavement.

5-01.3(8) Sealing Existing Transverse and Longitudinal Joints

The Contractor shall clean and seal existing transverse and longitudinal joints where shown in the Plans or as marked by the Project Engineer.

Old sealant and incompressible material shall be completely removed from the joint to the depth of the new reservoir with a diamond blade saw. The removed sealant shall become the property of the Contractor and be removed from the jobsite.

Removal of the old sealant for the entire depth of the joint is not required if the depth of the new reservoir is less than the depth of the existing joint.

Joints constructed with joint tape do not require cleaning and sealing.

Immediately prior to sealing, the cracks shall be blown clean with dry oil-free compressed air. The joints shall be completely dry before the sealing installation may begin. Immediately following the air blowing, the sealant material shall be installed in conformance to manufacturer's recommendations and in accordance with Section 5-05.3(8)B.

The top surface of the sealant shall be at least $\frac{1}{4}$ -inch below the surface of the pavement.

5-01.3(9) Portland Cement Concrete Pavement Grinding

Pavement grinding shall begin within 10-working days of placing dowel bar retrofit patching materials. Once the grinding operation has started it shall be continuous until completed. The right travel lane in the direction of traffic shall be ground first.

The pavement shall be ground in a longitudinal direction beginning and ending at lines normal to the pavement centerline. The minimum overlap between longitudinal passes shall be 2.0-inches. Ninety-five-percent of the surface area of the pavement to be ground shall have a minimum of $\frac{1}{8}$ -inch removed by grinding.

Bridge decks, bridge approach slabs and bridge overlay insets shall not be ground. The ground pavement shall be feathered to match the elevation of the above features.

5-01.3(9)A Surface Finish

The final surface texture shall be uniform in appearance with longitudinal corduroy type texture. The grooves shall be between $\frac{3}{32}$ and $\frac{1}{16}$ -inches wide, and no deeper than $\frac{1}{16}$ -inch. The land area between the grooves shall be between $\frac{1}{16}$ and $\frac{1}{8}$ -inches wide.

5-01.3(10) Pavement Smoothness

Perform the Work described in Section 5-05.3(12), and the following:

Where the pavement is ground, calculation of the profile index shall exclude dips and depressions in the existing Roadway. The profilograph generated reports shall be provided to the Project Engineer prior to payment. The smoothness perpendicular to the centerline will be measured with a 10-foot straight edge within the lanes. There shall be no vertical elevation differences of more than a 1/4-inch between lanes.

5-01.3(11) Concrete Slurry

All concrete slurry and grinding residue shall be removed from the Roadway on a continual basis immediately behind the grinding or cutting operations. Slurry shall not be allowed to drain across open traffic lanes and Shoulders. Slurry shall not be allowed to drain into any waterway, placed on the Roadway slope within 200-feet of any waterway, or other areas as designated by the Project Engineer. Prior to commencing grinding or cutting operations, the Contractor shall submit to the Project Engineer for approval a plan to prevent contaminants, such as grinding slurry or concrete debris, from entering ditches, culverts, or other waterways, including wetlands or aquifers.

Concrete slurry shall be collected from the Roadway and disposed of by the Contractor off the project site. The Contractor shall provide a copy of the permit for an approved waste site for the disposal of the slurry prior to the start of the grinding.

Opening to traffic shall meet the requirements of Section 5-05.3(17).

5-01.4 Measurement

Replacement cement concrete panels will be measured by the square yard, based on the actual width and length of the surface area placed.

Retrofit dowel bars will be measured per each for the actual number of bars used in the completed Work.

No specific unit of measure will apply to the force account item of partial depth spall repair.

Sealing existing concrete random cracks will be measured by the linear foot, measured along the crack sealed.

Sealing transverse and longitudinal joints will be measured by the linear foot, measured along the line of the completed joint.

Cement concrete pavement grinding will be measured by the square yard, based on the actual width and length of area ground. Extra passes to meet the Specifications or overlaps will not be measured.

No specific unit of measure will apply to the force account item of replace uncompactable material.

5-01.5 Payment

Payment will be made in accordance with Section 1-04.1, for each of the following Bid items that are included in the Proposal:

“Replace Cement Concrete Panel”, per square yard.

The unit Contract price per square yard shall be full payment for all costs to complete the Work as specified, including saw cutting full depth, removal and disposal of the existing panels off of the Contracting Agency’s Right of Way, preparing the surfacing below the new panel, provide, place and compact the crushed surfacing or hot mix asphalt, furnishing and placing polyethylene film or building paper, furnishing and placing the portland cement concrete, drilling the holes, providing and anchoring the dowel bars and tie bars, and for all incidentals required to complete the Work as specified.

“Retrofit Dowel Bars”, per each.

The unit Contract price per each shall be full payment for all costs to complete the Work as specified, including furnishing and installing parting compound, dowel bar expansion caps, caulking filler, foam core insert material, cement patch where pavement is removed for dowel bar retrofit and for all incidentals required to complete the Work as specified.

“Partial Depth Spall Repair”, by force account as provided in Section 1-09.6.

To provide a common Proposal for all Bidders, the Contracting Agency has entered an amount in the Proposal to become a part of the total Bid by the Contractor.

“Sealing Existing Concrete Random Crack”, per linear foot.

The unit Contract price per linear foot for “Sealing Existing Concrete Random Crack” shall be full payment for all costs to complete the Work as specified, including removing incompressible material, preparing and sealing existing random cracks where existing random cracks are cleaned and for all incidentals required to complete the Work as specified.

“Sealing Transverse and Longitudinal Joints”, per linear foot.

The unit Contract price per linear foot for “Sealing Transverse and Longitudinal Joints”, shall be full payment for all costs to complete the Work as specified, including removing incompressible material, preparing and sealing existing transverse and longitudinal joints where existing transverse and longitudinal joints are cleaned and for all incidentals required to complete the Work as specified.

“Cement Concrete Pavement Grinding”, per square yard.

The unit Contract price per square yard for “Cement Concrete Pavement Grinding”, when multiplied by the number of units measured, shall be full payment for all costs to complete the Work as specified. The costs of any additional pavement grinding and profiling required to complete the Work as specified is also included in this payment.

“Replace Uncompactable Material”, by force account as provided in Section 1-09.6.

Payment for “Replace Uncompactable Material” will be by force account as provided in Section 1-09.6 and will be full payment for all work required to replace uncompactable material and provide base for the Concrete panel. This will include, but not be limited to, excavating the subgrade, placement of a soil stabilization construction geotextile, and backfilling with crushed surfacing base course, as well as the work detailed in items 1 through 5 noted in 5-01.3(4). For the purpose of providing a common Proposal for Bidders, the Contracting Agency has entered an amount in the Proposal to become a part of the total Bid by the Contractor.

All costs associated with the containment, collection and disposal of concrete slurry and grinding residue shall be included in the applicable concrete grinding or cutting items of Work.

5-02 BITUMINOUS SURFACE TREATMENT

5-02.1 Description

This Work shall consist of constructing a single or multiple course bituminous surface treatment (BST) in accordance with these Specifications and in conformity with the lines and cross-sections shown in the Plans or as designated by the Engineer.

5-02.1(1) New Construction

This method of treatment requires two applications of asphalt emulsion and three applications of aggregate. The initial application of asphalt emulsion is a prime coat applied to an untreated Roadway that is followed with an application of aggregate. The second application of asphalt emulsion is the tack coat and is followed with two additional applications of aggregate.

5-02.1(2) Seal Coats

This method require the placing of one application of asphalt emulsion and one or more sizes of aggregate as specified to an existing pavement to seal and rejuvenate the surface and to produce a uniform Roadway surface with acceptable nonskid characteristics.

5-02.1(3) Pavement Sealers – Fog Seal

This method of treatment requires an application of asphalt emulsion over an existing or newly constructed pavement as specified.

5-02.2 Materials

Materials shall meet the requirements of the following sections:

Cationic Emulsified Asphalt	9-02.1(6)
Aggregates for Bituminous Surface Treatment	9-03.4

Aggregate to be used for bituminous surface treatment shall be of the type and size called for in the Plans or in the Proposal.

The asphalt emulsion to be used shall be the product which is called for in the Special Provisions, the Proposal, or shown in the Plans, and may be conditionally accepted at the source.

5-02.3 Construction Requirements

5-02.3(1) Equipment

The equipment used by the Contractor shall be subject to approval by the Engineer before its use.

The distributor shall be capable of uniformly applying asphalt emulsion at the required application temperature and rate. Temperature measuring devices shall be capable of reporting the temperature of asphalt emulsion in the tank and also the temperature of the asphalt emulsion being applied to the Roadway. A tachometer shall be required to accurately control the application of asphalt emulsion. Distributors shall be equipped with an adjustable spray bar with pressure pump and gauge. The power for operating the pressure pump shall be supplied by a power unit which will provide a uniform spray from each of the nozzles across the spray bar and extensions. The distributor truck shall have a volume control gauge. All reading devices and gauges shall be easily accessible by Inspectors from the ground.

Rollers for seal coats shall be self-propelled pneumatic tired rollers. Rollers for new construction shall be a combination of self-propelled pneumatic tired rollers and smooth-wheeled rollers. Each roller shall not weigh less than 12-tons and shall be capable of providing constant contact pressure. Operation of the roller shall be in accordance with the manufacturer's recommendations.

Aggregate spreading equipment shall be self-propelled, supported on at least four pneumatic tires, with an approved device for accurately metering and distributing the aggregate uniformly over the Roadway surface. Spreading equipment shall be so equipped that the operator has positive width control. This control shall allow the operator to adjust the spreading width of aggregates in 6-inch increments without stopping the machine.

Brooms shall be motorized and capable of controlling vertical pressure.

Other equipment necessary to satisfactorily perform the Work as specified herein or as designated by the Engineer shall be subject to approval by the Engineer before its use in the Work.

Additional units shall be used in the Work when, in the opinion of the Engineer, it is considered necessary in order to fulfill the requirements of these Specifications, or to complete the Work within the time specified.

5-02.3(2) Preparation of Roadway Surface

5-02.3(2)A New Construction

The existing Roadway surface shall be shaped to a uniform grade and cross-section as shown in the Plans, or as designated by the Project Engineer.

The Roadway shall be dampened, bladed and rolled until the entire Roadway surface shows a uniform grading and conforms to the line, grade, and cross-section shown in the Plans, or as staked. During the operation of blading and rolling, water shall be applied, if necessary, in the amount and at the locations designated by the Project Engineer.

The entire surface shall be rolled with a smooth-wheeled or pneumatic-tired roller, or both, as designated by the Engineer, except that the final rolling shall be accomplished with a smooth-wheeled roller as specified in Section 5-02.3(1). Rolling shall continue until the entire Roadway presents a firm, damp and unyielding surface.

Immediately before the prime coat of asphalt emulsion is applied, the Roadway surface shall be in the following condition: firm and unyielding, damp, free from irregularities and material segregation, and true to line, grade, and cross-section.

No traffic will be allowed on the prepared surface until the prime coat of asphalt emulsion and aggregate is applied.

5-02.3(2)B Seal Coats

The existing bituminous surface shall be swept with a power broom until it is free from dirt or other foreign matter. Hand push brooms shall be used to clean omissions of the power broom. In addition to power and hand brooms, the use of other equipment may be necessary to thoroughly clean the Roadway prior to the application of asphalt emulsion. Berms created by the removal of dirt or other foreign matter shall be evenly distributed over the fore slope.

Repair of existing pavement shall be done in accordance with Section 5-04. The HMA in repaired areas shall be fog sealed. HMA repaired areas may require a second fog seal depending on surface texture as required by the Project Engineer. The pavement surface shall be dry prior to fog sealing.

5-02.3(2)C Pavement Sealing – Fog Seal

Where shown in the Plans or directed by the Engineer, the Contractor shall apply a fog seal. Before application of the fog seal, all surfaces shall be thoroughly cleaned of dust, soil, pavement grindings, and other foreign matter. The existing pavement surface shall be dry.

5-02.3(2)D Soil Residual Herbicide

Where shown in the Plans, soil residual herbicide shall be applied in accordance with Section 5-04. Application of the BST shall begin within 24-hours after application of the herbicide.

5-02.3(3) Application of Asphalt Emulsion and Aggregate

Upon the properly prepared Roadway surface, asphalt emulsion of the grade specified in the Special Provisions shall be uniformly applied with distributors and specified aggregates spread at the following rates:

Application Rate			
	Undiluted Asphalt Emulsion (gal. per sq. yd.) Applied	Aggregate Size	Aggregates (lbs. per sq. yd.) Applied
New Construction			
Prime Coat	0.35-0.65	½- No. 4 or ¾-½	25-45
Seal Coat	0.35-0.60	½- No. 4	25-40
Choke Stone	N/A	No. 4 - 0	4-6
Seal Coats			
⅝-inch – No. 4 Choke Stone	0.40-0.65	⅝- No. 4 No. 4 - 0	25-45 4-6
½-inch – No. 4 Choke Stone	0.35-0.55	½- No. 4 No. 4 - 0	20-35 4-6
¾-inch – No. 4	0.35-0.55	¾- No. 4	20-30
¾-inch – No. 10	0.20-0.40	¾- No. 10	18-30
Choke Stone	N/A	No. 4 - 0	4-6

Pavement Sealing		
Grade	Diluted/Undiluted	Application Rate (gal/sy)
CSS-1 or CSS-1h	Diluted (One part water, one part emulsion)	0.10-0.18
CSS-1 or CSS-1h	Undiluted	0.05-0.09

The Project Engineer will determine the application rates. The second application of asphalt emulsion (seal coat) shall be applied the next day, or as approved by the Project Engineer.

Longitudinal joints will be allowed at only the centerline of the Roadway, the center of the driving lanes, or the edge of the driving lanes.

To ensure uniform distribution of asphalt emulsion and that the distributor is correctly calibrated, the Contractor shall provide a minimum 1,000-foot test strip when beginning a BST section.

To avoid gaps and ridges at transverse junctions of separate applications of asphalt emulsion and aggregate, the Contractor shall spread sufficient building paper over the treated surface to ensure that the distributor will be functioning normally when the untreated surface is reached. If ordered by the Project Engineer, the joints shall be cut back to a neat edge prior to placing the building paper.

Should ridges, overlaps, or gaps occur at transverse joints, the Contractor shall repair the defects to the satisfaction of the Project Engineer. In lieu of repair the Engineer may elect to accept the completed joints and will deduct from monies due or that may become due the Contractor, the sum of \$200 for each joint where the deviations described above are found. Should longitudinal joints occur outside the centerline of the Roadway, the center of the driving lanes, or the edge of the driving lanes, the Contractor shall repair the defects to the satisfaction of the Project Engineer.

All costs involved in making the corrections to defects described above shall be borne by the Contractor and no payment will be made for this Work.

Omissions (skips) by the distributor or tire marks on the uncovered asphalt emulsion shall be immediately covered by hand patching with the same grade of asphalt emulsion and aggregate used on the project.

The area covered by any one spread of asphalt emulsion shall be no more than can be covered with aggregate within 1-minute from the time of application upon any part of the spread. If field conditions warrant, this time may be increased as designated by the Project Engineer.

Unless otherwise designated by the Project Engineer, asphalt emulsion shall be spread toward the source of aggregate to avoid injury to the freshly treated surface.

Before application to the Roadway, asphalt emulsion shall be heated to the following temperatures or that recommended by the manufacturer:

Type and Grade of Asphalt Emulsion	Distributor Temperature	
	Min. °F	Max. °F
New Construction and Seal Coats:		
CRS-1, CRS-2, CRS-2P	125	195
CMS-2, CMS-2S, CMS-2h	125	185
Fog Seal:		
CSS-1, CSS-1h	70	140

Before application of the fog seal, all surfaces shall be thoroughly cleaned of dust, soil, pavement grindings, and other foreign matter. The fog seal shall be CSS-1 or CSS-1h emulsified asphalt uniformly applied to the pavement. The finished application shall be free of streaks and bare spots. The emulsified asphalt may be diluted at a rate of one part water to one part emulsified asphalt unless otherwise directed by the Project Engineer.

Fog sealing shall be applied no sooner than 3-days, but no later than 14-days after new construction or seal coat. If required, newly placed aggregates shall be swept prior to the fog seal application. Rebrooming for fog seal applications shall be paid under “Additional Brooming”, per hour as specified in Section 5-02.5.

5-02.3(4) Vacant**5-02.3(5) Application of Aggregates**

All aggregate stockpiles shall be watered down to provide aggregates that are uniformly damp at the time of placement on the Roadway.

After the asphalt emulsion has been spread evenly over the Roadway surface, aggregates of the type specified shall be evenly applied to the Roadway surface by spreader equipment.

The aggregate shall be spread in one operation in such a manner that an 8-inch strip of asphalt emulsion is left exposed along the longitudinal joint to form a lap for the succeeding applications of asphalt emulsion. If necessary, thin or bare spots in the spread of aggregate shall be corrected immediately by re-spreading with the chip spreader or by hand spreading the aggregate.

A minimum of 3 pneumatic tired rollers providing a minimum of 2 complete coverages to the Roadway immediately behind the spreading equipment for the coarse aggregate shall be required.

The maximum rate of roller travel shall be limited to 8 mph.

The Contractor shall apply choke aggregates to the Roadway with additional spreading equipment immediately following the initial rolling of the coarse aggregate unless otherwise specified in the Contract documents or ordered by the Project Engineer. Excess aggregate shall be removed from the Roadway. A minimum of 1 pass with a pneumatic roller shall be made across the entire width of the applied choke aggregate.

The operation of trucks hauling aggregate from the stockpile shall be so regulated that no damage, as determined by the Project Engineer, will result to the Highway or the freshly applied asphalt surface.

The completed surface shall be allowed to cure and then broomed as soon as practical.

If brooming causes rock to be turned or if the Project Engineer determines that additional cure is needed, the Contractor shall broom the Roadway when directed by the Project Engineer. If, after completion of the initial brooming, the Project Engineer determines the need to remobilize for additional brooming, the Contractor shall rebroom the areas designated by the Project Engineer. The Contractor shall apply water for dust control during brooming operations when safety or environmental concerns arise, or as otherwise determined by the Project Engineer.

The Contractor shall be held responsible for protecting all surface waters, riparian habitats, or other sensitive areas that may be encroached upon by brooming operations. Materials such as dirt, foreign material, or aggregates removed from these areas shall become the property of the Contractor and shall be disposed of in accordance with Section 2-03.3(7).

The Contractor shall use a pickup broom in all curbed areas, on all bridges, within city limits, within environmentally sensitive areas, and where shown in the Plans both before the application of asphalt emulsion and during the final brooming operation. When the pickup broom does not satisfactorily pickup the aggregate, manual methods shall be used. Materials collected by the pickup broom shall become the property of the Contractor and shall be disposed of in accordance with Section 2-03.3(7).

Aggregates accumulated in intersections and driveways due to brooming operations shall become the property of the Contractor and shall be disposed of in accordance with Section 2-03.3(7).

The Contractor shall notify the Project Engineer when the brooming for each section is considered complete. The Project Engineer will indicate acceptance or inform the Contractor of deficiencies within 24-hours of notification.

5-02.3(6) Additional Asphalt Emulsion and Aggregate

If the application of asphalt emulsion or aggregate, or both, is insufficient or excessive for the required results, the Project Engineer may require the Contractor to make an additional application of one or both materials in accordance with these Specifications, or at the direction of the Project Engineer. Additional asphalt emulsion or aggregate used will be paid for at the unit Contract prices for the materials used.

5-02.3(7) Patching and Correction of Defects

Omissions by the distributor or damage to the treated surface of any coat shall be immediately covered by hand patching with asphalt emulsion in adequate quantities. Holes which develop in the surface shall be patched in the same manner as specified in Section 5-02.3(2)A. All costs incurred by the Contractor, in coating omissions and patching, shall be included in the unit Contract prices for the materials used.

Defects such as raveling, lack of uniformity, or other imperfections caused by faulty workmanship shall be corrected and new Work shall not be started until such defects have been remedied.

All improper workmanship and defective materials resulting from overheating, improper handling or application, shall be removed from the Roadway by the Contractor and be replaced with approved materials and workmanship at no expense to the Contracting Agency.

If the Engineer determines a fog seal is necessary at any time during the life of the Contract, the Contractor shall apply a fog seal. The CSS-1 or CSS-1h emulsified asphalt may be diluted with water at a rate of 1-part water to 1-part emulsified asphalt unless otherwise directed by the Project Engineer.

5-02.3(8) Progress of Work

The Contractor shall organize the Work so that no longitudinal joints shall remain open overnight.

5-02.3(9) Protection of Structures

The Contractor shall be responsible for protecting monument covers, sewer lids, manhole covers, water valve covers, drainage grates, inlets, railroad tracks, bridge handrails and expansion joints, guardrails, curbs, road signs, guide posts or other facilities from the application of asphalt emulsion and aggregates. This protective effort is to include uncovering these items the same working day that the completed BST or seal coat construction has passed the protected locations. If needed, drainage inlets shall be cleaned out immediately after final brooming is completed. All costs incurred by the Contractor in necessary protective measures shall be included in the unit Contract prices for the various Bid items of Work involved.

5-02.3(10) Unfavorable Weather

Asphalt emulsion shall not be applied to a wet Roadway. Subject to the determination of the Project Engineer, asphalt emulsion shall not be applied during rainfall, sand or dust storms, or before any imminent storms that might damage the construction. The Project Engineer will have the discretion as to whether the surface and materials are dry enough to proceed with construction.

The application of any asphalt emulsion to the Roadway shall be restricted to the following conditions:

1. The Roadway surface temperature shall be at least 55°F. The air temperature shall be at least 60°F and rising. The air temperature shall be not less than 70°F when falling and the wind shall be less than 10-miles per hour as estimated by the Project Engineer.

2. The surface temperature shall be not more than 130°F or as otherwise determined by the Project Engineer.
3. No asphalt emulsion shall be applied which cannot be covered 1-hour before darkness. The Project Engineer may require the Contractor to delay application of asphalt emulsion until the atmospheric and Roadway conditions are satisfactory.
4. Construction of bituminous surface treatments shall not be carried out before May 1 or after August 31 of any year except upon written order of the Project Engineer.

5-02.3(11) Temporary Raised Pavement Markings

During bituminous surface treatment paving operations, temporary raised pavement markings shall be maintained throughout the project. Temporary raised pavement markings shall be installed on the Roadway that was paved that day. Temporary raised pavement markings shall be in accordance with Section 8-23.

5-02.4 Measurement

Processing and finishing will be measured by the mile to the nearest 0.01-mile along the main line Roadway. All related supplemental Roadways and irregular shaped areas will be incidental.

Asphalt emulsion of the grade or grades specified will be measured by the ton in accordance with Section 1-09.

Asphalt for fog seal will be measured by the ton, before dilution, in accordance with Section 1-09.

Aggregate from stockpile for BST will be measured by the cubic yard in trucks at the point of delivery on the Roadway.

Furnishing and placing crushed aggregate will be measured by the cubic yard in trucks at the point of delivery on the Roadway, or by the ton in accordance with Section 1-09.1.

Additional brooming will be measured by the hour.

Water will be measured in accordance with Section 2-07.

No specific unit of measure will apply to the calculated item of asphalt emulsion price adjustment.

5-02.5 Payment

Payment will be made in accordance with Section 1-04.1, for each of the following Bid items that are included in the Proposal:

“Processing and Finishing”, per mile.

The unit Contract price per mile for “Processing and Finishing” shall be full pay for all labor and equipment required for blading, scarifying, processing, leveling, finishing, and the manipulation of aggregates as required. In the event the Proposal does not include a Bid item for “Processing and Finishing” then all costs for processing and finishing shall be included in other related items of Work.

“Asphalt Emulsion (_____)”, per ton.

The unit Contract price per ton for “Asphalt Emulsion (_____)” shall be full pay for furnishing the asphalt emulsion and for all labor and equipment for heating, hauling, and spreading on the Roadway.

“Asphalt for Fog Seal”, per ton.

The unit Contract price per ton for “Asphalt for Fog Seal” shall be full pay for all costs of material, labor, tools and equipment necessary for the application of the fog seal as specified.

“Agg. from Stockpile for BST”, per cubic yard.

The unit Contract price per cubic yard for “Aggregate from Stockpile for BST” shall be full pay for all labor and equipment required for loading, transporting, and placing the material in the finished Work.

“Furnishing and Placing Crushed ()”, per cubic yard.

“Furnishing and Placing Crushed ()”, per ton.

The unit Contract price per cubic yard or per ton for “Furnishing and Placing Crushed ()” shall be full pay for all labor and equipment required for furnishing, transporting and placing the material in the finished Work.

“Additional Brooming”, per hour.

The unit Contract price per hour for “Additional Brooming” shall be full pay for all labor and equipment necessary to rebroom the Roadway as specified.

“Water”, per M gal.

Payment for “Water” shall be in accordance with Section 2-07.5.

“Asphalt Emulsion Price Adjustment”, by calculation

“Asphalt Emulsion Price Adjustment” will be calculated and paid for as described in Section 5-02.3(4).

If the Proposal does not include a Bid item for water, the Contractor shall dampen stockpiled or furnished aggregate as required, and the cost thereof shall be included in other related items of the Work.

Any incidental Work required to complete the bituminous surface treatment that is not specifically mentioned as included with the Bid items above shall be performed by the Contractor and shall be included in the unit Contract prices of the various related Bid items.

5-03 VACANT

5-04 HOT MIX ASPHALT

5-04.1 Description

This Work shall consist of providing and placing 1 or more layers of plant-mixed hot mix asphalt (HMA) on a prepared foundation or base in accordance with these Specifications and the lines, grades, thicknesses, and typical cross-sections shown in the Plans. The manufacture of HMA may include warm mix asphalt (WMA) processes in accordance with these Specifications. WMA processes include organic additives, chemical additives, and foaming.

HMA shall be composed of asphalt binder and mineral materials as may be required, mixed in the proportions specified to provide a homogeneous, stable, and workable mixture.

5-04.2 Materials

Materials shall meet the requirements of the following sections:

Asphalt Binder	9-02.1(4)
Cationic Emulsified Asphalt	9-02.1(6)
Anti-Stripping Additive	9-02.4
Warm Mix Asphalt Additive	9-02.5
Aggregates	9-03.8
Recycled Asphalt Pavement	9-03.8(3)B
Blending Sand	9-03.8(4)
Mineral Filler	9-03.8(5)
Recycled Material	9-03.21

The Contract documents may establish that the various mineral materials required for the manufacture of HMA will be furnished in whole or in part by the Contracting Agency. If the documents do not establish the furnishing of any of these mineral materials by the Contracting Agency, the Contractor shall be required to furnish such materials in the amounts required for the designated mix. Mineral materials include coarse and fine aggregates, blending sand, and mineral filler.

The Contractor may choose to utilize recycled asphalt pavement (RAP) in the production of HMA. If utilized, the amount of RAP shall not exceed 20-percent of the total weight of the HMA. The RAP may be from pavements removed under the Contract, if any, or pavement material from an existing stockpile.

The grade of asphalt binder shall be as required by the Contract. Prior to the submittal of the mix design, the Contractor shall provide a written designation of the grade of PG asphalt binder to be used. The Contractor may propose the substitution of alternate grades of performance grade (PG) asphalt binder at no cost to the Contracting Agency. The proposal will be approved if the proposed alternate asphalt binder has an average 7-day maximum pavement design temperature that is equal to or higher than the specified asphalt binder and has a minimum pavement design temperature that is equal to or lower than the specified asphalt binder. The substituted asphalt binder shall not exceed a one grade change for either of the design temperatures with a minimum pavement design temperature no lower than minus 28°C. The substituted alternate grade of asphalt binder shall be used in all HMA Contract items of the same class and originally specified grade of asphalt binder. Blending of asphalt binder from different sources is not permitted.

The Contractor may use warm mix asphalt (WMA) processes in the production of HMA. The Contractor shall submit to the Engineer for approval the process that is proposed and how it will be used in the manufacture of HMA.

When the Contracting Agency provides aggregates or provides a source for the production of aggregates, the Contract Provisions will establish the approximate percentage of asphalt binder required in the mixture for each class of HMA.

Production of aggregates shall comply with the requirements of Section 3-01.

Preparation of stockpile site, the stockpiling of aggregates, and the removal of aggregates from stockpiles shall comply with the requirements of Section 3-02.

5-04.3 Construction Requirements

5-04.3(1) HMA Mixing Plant

Plants used for the preparation of HMA shall conform to the following requirements:

1. **Equipment for Preparation of Asphalt Binder.** Tanks for the storage of asphalt binder shall be equipped to heat and hold the material at the required temperatures. The heating shall be accomplished by steam coils, electricity, or other approved means so that no flame shall be in contact with the storage tank. The circulating system for the asphalt binder shall be designed to ensure proper and continuous circulation during the operating period. A valve for the purpose of sampling the asphalt binder shall be placed in either the storage tank or in the supply line to the mixer.
2. **Thermometric Equipment.** An armored thermometer, capable of detecting temperature ranges expected in the HMA mix, shall be fixed in the asphalt binder feed line at a location near the charging valve at the mixer unit. The thermometer location shall be convenient and safe for access by Inspectors. The plant shall also be equipped with an approved dial-scale thermometer, a mercury actuated thermometer, an electric pyrometer, or another approved thermometric instrument placed at the discharge chute of the drier to automatically register or indicate the temperature of the heated aggregates. This device shall be in full view of the plant operator.
3. **Heating of Asphalt Binder.** The temperature of the asphalt binder shall not exceed the maximum recommended by the asphalt binder manufacturer. The asphalt binder shall be heated in a manner that will avoid local variations in heating. The heating method shall provide a continuous supply of asphalt binder to the mixer at a uniform average temperature with no individual variations exceeding 25°F. Also, when a WMA additive is included in the asphalt binder, the temperature of the asphalt binder shall not exceed the maximum recommended by the manufacturer of the WMA additive.
4. **Sampling and Testing of Mineral Materials.** The HMA plant shall be equipped with a mechanical sampler for the sampling of the mineral materials. The mechanical sampler shall meet the requirements of Section 1-05.6 for the crushing and screening operation. The Contractor shall provide sufficient space as required for the setup and operation of the field testing facilities of the Contracting Agency.
5. **Sampling HMA.** The HMA plant shall provide for sampling HMA by one of the following methods:
 - a. A mechanical sampling device attached to the HMA plant.
 - b. Platforms or devices to enable sampling from the hauling vehicle without entering the hauling vehicle.

5-04.3(2) Hauling Equipment

Trucks used for hauling HMA shall have tight, clean, smooth metal beds and shall have a cover of canvas or other suitable material of sufficient size to protect the mixture from adverse weather. Whenever the weather conditions during the workshift include, or

are forecast to include, precipitation or an air temperature less than 45°F, the cover shall be securely attached to protect the HMA.

In order to prevent the HMA mixture from adhering to the hauling equipment, truck beds are to be sprayed with an environmentally benign release agent. Excess release agent shall be drained prior to filling hauling equipment with HMA. Petroleum derivatives or other coating material that contaminate or alter the characteristics of the HMA shall not be used. For hopper trucks, the conveyer shall be in operation during the process of applying the release agent.

5-04.3(3) Hot Mix Asphalt Pavers

HMA pavers shall be self-contained, power-propelled units, provided with an internally heated vibratory screed and shall be capable of spreading and finishing courses of HMA plant mix material in lane widths required by the paving section shown in the Plans.

Prior to the use of any HMA paver, the Contractor shall certify the paver is equipped with the most current equipment available from the manufacturer for the prevention of the segregation of the coarse aggregate particles. The certification shall list the make, model, and year of the paver and any equipment that has been retrofitted to the paver.

The screed shall be operated in accordance with the manufacturer's recommendations and shall effectively produce a finished surface of the required evenness and texture without tearing, shoving, segregating, or gouging the mixture. A copy of the manufacturer's recommendations shall be provided upon request by the Contracting Agency. Extensions will be allowed provided they produce the same results, including ride, density, and surface texture as obtained by the primary screed. Extensions without augers and an internally heated vibratory screed shall not be used in the Traveled Way.

The paver shall be equipped with automatic screed controls with sensors for either or both sides of the paver. The controls shall be capable of sensing grade from an outside reference line, sensing the transverse slope of the screed, and providing automatic signals that operate the screed to maintain the desired grade and transverse slope. The sensor shall be constructed so it will operate from a reference line or a mat referencing device.

The transverse slope controller shall be capable of maintaining the screed at the desired slope within plus or minus 0.1-percent. The paver shall be equipped with automatic feeder controls, properly adjusted to maintain a uniform depth of material ahead of the screed.

Manual operation of the screed will be permitted in the construction of irregularly shaped and minor areas. These areas include, but are not limited to, gore areas, road approaches, tapers and left-turn channelizations.

When specified in the Contract, reference lines for vertical control will be required. Lines shall be placed on both outer edges of the Traveled Way of each Roadway. Horizontal control utilizing the reference line will be permitted. The grade and slope for intermediate lanes shall be controlled automatically from reference lines or by means of a mat referencing device and a slope control device. When the finish of the grade prepared for paving is superior to the established tolerances and when, in the opinion of the Project Engineer, further improvement to the line, grade, cross-section, and smoothness can best be achieved without the use of the reference line, a mat referencing device may be substituted for the reference line. Substitution of the device will be subject to the continued approval of the Project Engineer. A joint matcher may be used subject to the approval of the Project Engineer. The reference line may be removed after the completion of the first course of HMA when approved by the Project Engineer. Whenever the Engineer determines that any of these methods are failing to provide the necessary vertical control, the reference lines will be reinstalled by the Contractor.

The Contractor shall furnish and install all pins, brackets, tensioning devices, wire, and accessories necessary for satisfactory operation of the automatic control equipment.

If the paving machine in use is not providing the required finish, the Project Engineer may suspend Work as allowed by Section 1-08.6. Any cleaning or solvent type liquids spilled on the pavement shall be thoroughly removed before paving proceeds.

5-04.3(3)A Material Transfer Device/Vehicle

Direct transfer of HMA from the hauling equipment to the paving machine will not be allowed in the top 0.30-foot of the pavement section of hot mix asphalt (HMA) used in traffic lanes with a depth of 0.08-foot or greater. A material transfer device or vehicle (MTD/V) shall be used to deliver the HMA from the hauling equipment to the paving machine. HMA placed in irregularly shaped and minor areas such as road approaches, tapers, and turn lanes are excluded from this requirement.

The MTD/V shall mix the HMA after delivery by the hauling equipment and prior to laydown by the paving machine. Mixing of the HMA shall be sufficient to obtain a uniform temperature throughout the mixture. If a windrow elevator is used, the length of the windrow may be limited in urban areas or through intersections, at the discretion of the Project Engineer.

5-04.3(4) Rollers

Rollers shall be of the steel wheel, vibratory, or pneumatic tire type, in good condition and capable of reversing without backlash. Operation of the roller shall be in accordance with the manufacturer's recommendations. When ordered by the Project Engineer for any roller planned for use on the project, the Contractor shall provide a copy of the manufacturer's recommendation for the use of that roller for compaction of HMA. The number and weight of rollers shall be sufficient to compact the mixture in compliance with the requirements of Section 5-04.3(10). The use of equipment that results in crushing of the aggregate will not be permitted. Rollers producing pickup, washboard, uneven compaction of the surface, displacement of the mixture or other undesirable results shall not be used.

5-04.3(5) Conditioning of Existing Surface

When the surface of the existing pavement or old base is irregular, the Contractor shall bring it to a uniform grade and cross-section as shown on the Plans or approved by the Project Engineer.

Preleveling of uneven or broken surfaces over which HMA is to be placed may be accomplished by using an asphalt paver, a motor patrol grader, or by hand raking, as approved by the Project Engineer.

5-04.3(5)A Preparation of Existing Surfaces

Before construction of HMA on an existing paved surface, the entire surface of the pavement shall be clean. All fatty asphalt patches, grease drippings, and other objectionable matter shall be entirely removed from the existing pavement. All pavements or bituminous surfaces shall be thoroughly cleaned of dust, soil, pavement grindings, and other foreign matter. All holes and small depressions shall be filled with an appropriate class of HMA. The surface of the patched area shall be leveled and compacted thoroughly.

A tack coat of asphalt shall be applied to all paved surfaces on which any course of HMA is to be placed or abutted. Tack coat shall be uniformly applied to cover the existing pavement with a thin film of residual asphalt free of streaks and bare spots. A heavy application of tack coat shall be applied to all joints. For Roadways open to traffic, the application of tack coat shall be limited to surfaces that will be paved during the same working shift. The spreading equipment shall be equipped with a thermometer to indicate the temperature of the tack coat material.

Equipment shall not operate on tacked surfaces until the tack has broken and cured. If the Contractor's operation damages the tack coat it shall be repaired prior to placement of the HMA.

Unless otherwise approved by the Engineer, the tack coat shall be CSS-1, CSS-1h, or STE-1 emulsified asphalt. The CSS-1 and CSS-1h emulsified asphalt may be diluted with water at a rate not to exceed 1-part water to 1-part emulsified asphalt. The tack coat shall not exceed the maximum temperature recommended by the emulsified asphalt manufacturer.

5-04.3(5)B Preparation of Untreated Roadway

When designated in the Plans the existing Roadway shall be prepared and primed. The Roadway preparation shall be performed in accordance with the Bituminous Surface Treatment provisions for this type of Work (Section 5-02.3(2)A), except that only one application of asphalt and one application of aggregate shall be applied. The aggregate shall conform either to the requirements of Section 9-03.4, 9-03.8 or shall consist of other material approved by the Engineer. All other provisions of Section 5-02 pertaining to New Construction bituminous surface treatments shall apply to this preparation Work, except as hereinafter modified.

The prime coat shall be applied over the full length of the project. HMA shall not be placed until the prime coat has cured for 5-days unless otherwise approved by the Engineer.

Should any holes, breaks, or irregularities develop in the Roadway surface after the prime coat has been applied, they shall be patched, as described in Section 5-04.3(5)A, before placement of the HMA pavement. The Contractor shall maintain the completed prime coat by blading or brooming with equipment and procedures approved by the Engineer, until the HMA pavement is placed.

After the maintenance, patching or repair Work has been completed and immediately prior to placing the HMA, the surface of the prime coat shall be swept clean of all dirt, dust, or other foreign matter.

When the prime coat application is not specified in the Special Provisions or shown in the Plans, the Contractor shall prepare the untreated Roadway as described above and shall omit the prime coat treatment. The HMA shall be constructed on the prepared Subgrade.

The Contractor shall prepare untreated Shoulders and traffic islands by blading and compacting to provide a sound base for paving and shall omit the prime coat treatment. The HMA shall be constructed on the prepared Subgrade.

5-04.3(5)C Crack Sealing

When the Proposal includes a pay item for crack sealing, all cracks and joints $\frac{1}{4}$ -inch and greater in width shall be cleaned with a stiff-bristled broom and compressed air and then shall be filled completely with sand slurry.

The sand slurry shall consist of approximately 20-percent CSS-1 emulsified asphalt, approximately 2-percent Portland cement, water (if required), and the remainder clean No. 4-0 paving sand. The components shall be thoroughly mixed and then poured into the cracks and joints until full. The following day, any cracks or joints that are not completely filled shall be topped off with additional sand slurry. After the sand slurry is placed, the filler shall be struck off flush with the existing pavement surface and allowed to cure. The HMA overlay shall not be placed until the slurry has fully cured. The requirements of Section 1-06 will not apply to the Portland cement and paving sand used in the sand slurry.

5-04.3(5)D Soil Residual Herbicide

Where shown in the Plans, the Contractor shall apply one application of an approved soil residual herbicide. The requirements of Section 8-02.3(2)A shall apply to this application. Paving shall begin within 24-hours after application of the herbicide.

The material to be used shall be registered with the Washington State Department of Agriculture for use under pavement. Before use, the Contractor shall obtain approval of the material to be used and the proposed rate of application from the Project Engineer. The following information shall be included in the request for approval of the material:

1. Brand Name of the Material;
2. Manufacturer;
3. Environmental Protection Agency (EPA) Registration Number;
4. Material Safety Data Sheet; and
5. Proposed Rate of Application.

5-04.3(5)E Pavement Repair

The Contractor shall excavate pavement repair areas and shall backfill these with HMA in accordance with the details shown in the Plans and as staked. The Contractor shall conduct the excavation operations in a manner that will protect the pavement that is to remain. Pavement not designated to be removed that is damaged as a result of the Contractor's operations shall be repaired by the Contractor to the satisfaction of the Project Engineer at no cost to the Contracting Agency. The Contractor shall excavate only within one lane at a time unless approved otherwise by the Project Engineer. The Contractor shall not excavate more area than can be completely finished during the same shift.

The Project Engineer will determine the excavation depth, which may vary up to a total depth of 1-foot. The determination will depend on the location of material suitable for support of the pavement. The minimum width of any pavement repair area shall be 3-feet unless shown otherwise in the Plans. Before any excavation, the existing pavement shall be sawcut or shall be removed by a pavement grinder. Excavated materials will become the property of the Contractor and shall be disposed of in a Contractor-provided site off the Right of Way or used in accordance with Sections 2-02.3(3) or 9-03.21. Asphalt for tack coat shall be required as specified in Section 5-04.3(5)A. A heavy application of tack coat shall be applied to all surfaces of existing pavement in the pavement repair area. Placement of the HMA backfill shall be accomplished in lifts not to exceed 0.35-foot compacted depth. Each lift shall be thoroughly compacted by a mechanical tamper or a roller.

5-04.3(6) Vacant**5-04.3(7) Preparation of Aggregates**

The aggregates shall be stockpiled according to the requirements of Section 3-02. Sufficient storage space shall be provided for each size of aggregate. The aggregates shall be removed from stockpile(s) in a manner to ensure a minimum of segregation when being moved to the HMA plant for processing into the final mixture. Different aggregate sizes shall be kept separated until they have been delivered to the HMA plant.

5-04.3(7)A Mix Design**5-04.3(7)A1 General**

The Contractor shall develop a mix design prior to the initial production of HMA and prior to the production of HMA each calendar year thereafter. The mix design aggregate structure and asphalt binder content shall be determined in accordance with WSDOT Standard Operating Procedure 732 and meet the requirements of Sections

9-03.8(2) and 9-03.8(6). Mix designs that were developed during the calendar year prior to the current year's production of HMA that have been issued a WSDOT mix design report will be accepted provided the Contractor submits a certification letter stating that the aggregate and asphalt binder have not changed. Changes to aggregate that may require a new mix design include the source of material or a change in the percentage of material from a stockpile greater than 5-percent. Changes to asphalt binder that may require a new mix design include the source of the crude petroleum supplied to the refinery, the refining process, and additives or modifiers in the asphalt binder.

5-04.3(7)A2 Statistical or Nonstatistical Evaluation

Mix designs for HMA accepted by statistical and nonstatistical evaluation shall be submitted to the Project Engineer on DOT form 350-042. For a mix design that was originally developed for another WSDOT contract, the Contractor shall also submit DOT form 350-041 and include all changes to the job mix formula that have been approved on other contracts.

The Contractor shall submit representative samples of the mineral materials that are to be used in the HMA production. The Contracting Agency will use these samples to conduct verification testing of the mix design in accordance with WSDOT Standard Operating Procedure 732 and to determine anti-strip requirements, if any, in accordance with WSDOT test method T 718. Verification testing of HMA mix designs proposed by the Contractor that include RAP will be completed without the inclusion of the RAP. Submittal of RAP samples is not required. A mix design report will be provided within 25-calendar days after a mix design submittal has been received in the State Materials Laboratory in Tumwater. No paving shall begin prior to issuance of the mix design report or reference mix design report for that year.

5-04.3(7)A3 Commercial Evaluation

Mix designs for HMA accepted by commercial evaluation shall be submitted to the Project Engineer on DOT form 350-042; only the first page is required.

Verification of the mix design by the Contracting Agency is not required. The Project Engineer will determine anti-strip requirements for the HMA. Paving shall not begin before the anti-strip requirements have been provided to the Contractor. For commercial HMA, the Contractor shall select a class of HMA and design level of Equivalent Single Axle Loads (ESAL's) appropriate for the required use.

5-04.3(8) Mixing

After the required amounts of mineral materials and asphalt binder have been introduced into the mixer the HMA shall be mixed until a complete and uniform coating of the particles and a thorough distribution of the asphalt binder throughout the mineral materials is ensured.

When discharged, the temperature of the HMA shall not exceed the optimum mixing temperature by more than 25°F as shown on the mix design or reference mix design report or as approved by the Engineer. Also, when a WMA additive is included in the manufacture of HMA, the discharge temperature of the HMA shall not exceed the maximum recommended by the manufacturer of the WMA additive. A maximum water content of 2-percent in the mix, at discharge, will be allowed providing the water causes no problems with handling, stripping, or flushing. If the water in the HMA causes any of these problems, the moisture content shall be reduced as directed by the Project Engineer.

Storing or holding of the HMA in approved storage facilities will be permitted during the daily operation but in no event shall the HMA be held for more than 24-hours. HMA held for more than 24-hours after mixing shall be rejected. Rejected HMA shall be disposed of by the Contractor at no expense to the Contracting Agency. The storage facility shall have an accessible device located at the top of the cone or about the third

point. The device shall indicate the amount of material in storage. No HMA shall be accepted from the storage facility when the HMA in storage is below the top of the cone of the storage facility, except as the storage facility is being emptied at the end of the working shift.

Recycled asphalt pavement (RAP) utilized in the production of HMA shall be sized prior to entering the mixer so that a uniform and thoroughly mixed HMA is produced. If there is evidence of the recycled asphalt pavement not breaking down during the heating and mixing of the HMA, the Contractor shall immediately suspend the use of the RAP until changes have been approved by the Project Engineer.

5-04.3(8)A Acceptance Sampling and Testing—HMA Mixture

5-04.3(8)A1 General

Acceptance of HMA shall be as provided under statistical, nonstatistical, or commercial evaluation.

Acceptance of HMA by statistical evaluation is administered under the provisions of Section 5-04.5(1) Quality Assurance Price Adjustments. Statistical evaluation will be used for a class of HMA when the Proposal quantities for that class of HMA exceed 4,000-tons.

Nonstatistical evaluation will be used for the acceptance of HMA when the Proposal quantities for a class of HMA are 4,000-tons or less.

Commercial evaluation will be used for Commercial HMA and for other classes of HMA in the following applications: sidewalks, road approaches, ditches, slopes, paths, trails, gores, prelevel, and pavement repair. Other nonstructural applications of HMA accepted by commercial evaluation shall be as approved by the Project Engineer. Sampling and testing of HMA accepted by commercial evaluation will be at the option of the Project Engineer. The Proposal quantity of HMA that is accepted by commercial evaluation will be excluded from the quantities used in the determination of statistical and nonstatistical evaluation.

The mix design will be the initial JMF for the class of HMA. The Contractor may request a change in the JMF. Any adjustments to the JMF will require the approval of the Project Engineer and may be made in accordance with Section 9-03.8(7).

5-04.3(8)A2 Aggregate

For HMA accepted by statistical evaluation, the gradation of aggregates will be included in the statistical calculations. The acceptance criteria for aggregate properties of sand equivalent, uncompacted void content, and fracture will be their conformance to the requirements of Section 9-03.8(2). These properties will not be included in the statistical evaluation. Sampling and testing of aggregates accepted by commercial evaluation will be at the option of the Project Engineer.

5-04.3(8)A3 Sampling

The random sampling of HMA will be by WSDOT Test Method T 716. Samples for acceptance testing shall be obtained by the Contractor when ordered by the Engineer. The Contractor shall sample the HMA mixture in the presence of the Engineer and in accordance with WSDOT FOP for WAQTC/AASHTO T 168.

5-04.3(8)A4 Definition of Sampling Lot and Sublot

A lot is represented by randomly selected samples that will be tested for acceptance with a maximum of 15 sublots per lot; the final lot may be increased to 25 sublots. All of the test results obtained from the acceptance samples from a given lot shall be evaluated collectively. If the Contractor requests a change to the JMF that is approved, the material produced after the change will be evaluated on the basis of the new JMF for the remaining sublots in the current lot and for acceptance of subsequent lots. For a lot in

progress with a CPF less than 0.75, a new lot will begin at the Contractor's request after the Project Engineer is satisfied that material conforming to the Specifications can be produced.

Sampling and testing for statistical and nonstatistical evaluation shall be performed on the frequency of one sample per subplot. The sublots shall be approximately uniform in size with a maximum subplot size of 800-tons. The quantity of material represented by the final subplot for either statistical or nonstatistical evaluation may be increased to a maximum of two times the subplot quantity calculated. Should a lot accepted by statistical evaluation contain fewer than three sublots, the HMA will be accepted in accordance with nonstatistical evaluation

5-04.3(8)A5 Test Results

The results of all acceptance testing performed in the field and the Composite Pay Factor (CPF) of the lot after three sublots have been tested will be available to the Contractor through WSDOT's website.

The Contractor may request a subplot be retested. To request a retest, the Contractor shall submit a written request within 7-calendar days after the specific test results have been posted to the website. A split of the original acceptance sample will be sent for testing to either the Region Materials Laboratory or the State Materials Laboratory as determined by the Project Engineer. The split of the sample will not be tested with the same equipment or by the same tester that ran the original acceptance test. The sample will be tested for a complete gradation analysis, asphalt binder content, and Va, and the results of the retest will be used for the acceptance of the HMA in place of the original subplot sample test results. The cost of testing will be deducted from any monies due or that may come due the Contractor under the Contract at the rate of \$250 per sample.

5-04.3(8)A6 Test Methods

Testing of HMA for compliance of Va will be by WSDOT Standard Operating Procedure SOP 731. Testing for compliance of asphalt binder content will be by WSDOT FOP for AASHTO T 308. Testing for compliance of gradation will be by WAQTC FOP for AASHTO T 27/T 11.

5-04.3(8)A7 Test Section – HMA Mixtures

For each class of HMA accepted by statistical evaluation, the Contractor may request a test section to determine whether the mixture meets the requirements of Sections 9-03.8(2) and 9-03.8(6). The test section shall be constructed at the beginning of paving and will be at least 600-tons and a maximum of 1,000-tons or as approved by the Project Engineer. No further wearing or leveling HMA will be paved the day of or the day following the construction of the test section. The mixture in the test section will be evaluated as a lot with a minimum of three sublots required.

5-04.3(9) Spreading and Finishing

The mixture shall be laid upon an approved surface, spread, and struck off to the grade and elevation established. HMA pavers complying with Section 5-04.3(3) shall be used to distribute the mixture. Unless otherwise directed by the Engineer, the nominal compacted depth of any layer of any course shall not exceed the following:

HMA Class 1"	0.35-feet
HMA Class $\frac{3}{4}$ " and HMA Class $\frac{1}{2}$ "	
wearing course	0.30-feet
other courses	0.35-feet
HMA Class $\frac{3}{8}$ "	0.10-feet

On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the paving may be done with other equipment or by hand.

When more than 1 JMF is being utilized to produce HMA, the material produced for each JMF shall be placed by separate spreading and compacting equipment. The intermingling of HMA produced from more than 1 JMF is prohibited. Each strip of HMA placed during a work shift shall conform to a single JMF established for the class of HMA specified unless there is a need to make an adjustment in the JMF.

5-04.3(10) Compaction

5-04.3(10)A General

Immediately after the HMA has been spread and struck off, and after surface irregularities have been adjusted, the mix shall be thoroughly and uniformly compacted. The completed course shall be free from ridges, ruts, humps, depressions, objectionable marks, and irregularities and shall conform to the line, grade, and cross-section shown in the Plans. If necessary, the JMF may be altered in accordance with Section 9-03.8(7) to achieve desired results.

Compaction shall take place when the mixture is in the proper condition so that no undue displacement, cracking, or shoving occurs. Areas inaccessible to large compaction equipment shall be compacted by mechanical or hand tampers. Any HMA that becomes loose, broken, contaminated, shows an excess or deficiency of asphalt, or is in any way defective, shall be removed and replaced with new hot mix that shall be immediately compacted to conform to the surrounding area.

The type of rollers to be used and their relative position in the compaction sequence shall generally be the Contractor's option, provided the specified densities are attained. An exception shall be that pneumatic tired rollers shall be used for compaction of the wearing course beginning October 1st of any year through March 31st of the following year. Coverages with a vibratory or steel wheel roller may precede pneumatic tired rolling. Unless the Project Engineer has approved otherwise, vibratory rollers shall not be operated in the vibratory mode when the internal temperature of the mix is less than 175°F. Regardless of mix temperature, a vibratory roller shall not be operated in a vibratory mode when checking or cracking of the mat occurs. Rollers shall only be operated in static mode on bridge decks.

5-04.3(10)B Control

5-04.3(10)B1 General

HMA mixture accepted by statistical or nonstatistical evaluation that is used in traffic lanes, including lanes for ramps, truck climbing, weaving, and speed change, and having a specified compacted course thickness greater than 0.10-foot, shall be compacted to a specified level of relative density. The specified level of relative density shall be a Composite Pay Factor (CPF) of not less than 0.75 when evaluated in accordance with Section 1-06.2, using a minimum of 91.0-percent of the reference maximum density as determined by WSDOT FOP for AASHTO T 209. The specified level of density attained will be determined by the statistical evaluation of tests taken in accordance with FOP for WAQTC TM 8 and WSDOT SOP T 729 on the day the mix is placed (after completion of the finish rolling).

Each compaction lot will be divided into sublots with a maximum of 15 sublots per lot; the final lot may be increased to 25 sublots. Sublots will be uniform in size with a maximum of approximately 80-tons per subplot; the final subplot of the day may be increased to 120-tons. The subplot locations within each density lot will be determined by the stratified random sampling procedure conforming to WSDOT Test Method

T 716. For a lot in progress with a CPF less than 0.75, a new lot will begin at the Contractor's request after the Project Engineer is satisfied that material conforming to the Specifications can be produced.

HMA mixture accepted by commercial evaluation and HMA constructed under conditions other than those listed above shall be compacted on the basis of a test point evaluation of the compaction train. The test point evaluation shall be performed in accordance with instructions from the Project Engineer. The number of passes with an approved compaction train, required to attain the maximum test point density, shall be used on all subsequent paving.

HMA for preleveling shall be thoroughly compacted. HMA that is used for preleveling wheel rutting shall be compacted with a pneumatic tire roller unless otherwise approved by the Engineer.

5-04.3(10)B2 Cyclic Density

The Project Engineer may also evaluate the HMA for low cyclic density of the pavement in accordance with WSDOT SOP 733. Low cyclic density areas are defined as spots or streaks in the pavement that are less than 90.0-percent of the reference maximum density. Any area tested for density under Section 5-04.3(10)B1 will be included in this evaluation. A \$500 price adjustment will be assessed for any 500-foot section with two or more density readings below 90.0-percent of the reference maximum density.

5-04.3(10)B3 Longitudinal Joint Density

The Project Engineer will evaluate the HMA wearing surface for low density at the longitudinal joint in accordance with WSDOT SOP 735. Low density is defined as less than 90.0-percent of the reference maximum density. If one density reading, at either longitudinal joint, is below 90.0-percent of the reference maximum density, a \$200 price adjustment will be assessed for that subplot.

5-04.3(10)B4 Test Results

The nuclear moisture-density gauge results of all compaction acceptance testing and the CPF of the lot after three sublots have been tested will be available to the Contractor through WSDOT's website. Determination of the relative density of the HMA with a nuclear moisture-density gauge requires a correlation factor and may require resolution after the correlation factor is known. Acceptance of HMA compaction will be based on the statistical evaluation and CPF so determined.

For a subplot that did not meet the minimum of 91.0-percent of the reference maximum density in a compaction lot with a CPF below 1.00 and thus subject to a price reduction or rejection, the Contractor may request that a core be used for determination of the relative density of the subplot. The relative density of the core will replace the relative density determined by the nuclear moisture-density gauge for the subplot and will be used for calculation of the CPF and acceptance of HMA compaction lot. When cores are taken by the Contracting Agency at the request of the Contractor, they shall be requested by noon of the next workday after the test results for the subplot have been provided or made available to the Contractor. The core will be taken at approximately the same location as the nuclear moisture-density gauge test in the compaction subplot being challenged. Traffic control shall be provided by the Contractor as requested by the Project Engineer. Failure by the Contractor to provide the requested traffic control will result in forfeiture of the request for cores. When the CPF for the lot based on the results of the HMA cores is less than 1.00, the cost for the coring will be deducted from any monies due or that may become due the Contractor under the Contract at the rate of \$200 per core and the Contractor shall pay for the cost of the traffic control.

5-04.3(11) Reject Work**5-04.3(11)A General**

Work that is defective or does not conform to Contract requirements shall be rejected.

5-04.3(11)B Rejection by Contractor

The Contractor may, prior to sampling, elect to remove any defective material and replace it with new material. Any such new material will be sampled, tested, and evaluated for acceptance.

5-04.3(11)C Rejection Without Testing

The Project Engineer may, without sampling, reject any batch, load, or section of Roadway that appears defective. Material rejected before placement shall not be incorporated into the pavement. Any rejected section of Roadway shall be removed.

No payment will be made for the rejected materials or the removal of the materials unless the Contractor requests that the rejected material be tested. If the Contractor elects to have the rejected material tested, a minimum of three representative samples will be obtained and tested. Acceptance of rejected material will be based on conformance with the statistical acceptance Specification. If the CPF for the rejected material is less than 0.75, no payment will be made for the rejected material; in addition, the cost of sampling and testing shall be borne by the Contractor. If the CPF is greater than or equal to 0.75, the cost of sampling and testing will be borne by the Contracting Agency. If the material is rejected before placement and the CPF is greater than or equal to 0.75, compensation for the rejected material will be at a CPF of 0.75. If rejection occurs after placement and the CPF is greater than or equal to 0.75, compensation for the rejected material will be at the calculated CPF with an addition of 25-percent of the unit Contract price added for the cost of removal and disposal.

5-04.3(11)D Lots and Sublots**5-04.3(11)D1 A Partial Sublot**

In addition to the random acceptance sampling and testing, the Project Engineer may also isolate from a normal sublot any material that is suspected of being defective in relative density, gradation or asphalt binder content. Such isolated material will not include an original sample location. A minimum of 3 random samples of the suspect material will be obtained and tested. The material will then be statistically evaluated as an independent lot in accordance with Section 1-06.2(2).

5-04.3(11)D2 An Entire Sublot

An entire sublot that is suspected of being defective may be rejected. When a sublot is rejected a minimum of 2 additional random samples from this sublot will be obtained. These additional samples and the original sublot will be evaluated as an independent lot in accordance with Section 1-06.2(2).

5-04.3(11)D3 A Lot in Progress

The Contractor shall shut down operations and shall not resume HMA placement until such time as the Project Engineer is satisfied that material conforming to the Specifications can be produced:

- a. When the Composite Pay Factor (CPF) of a lot in progress drops below 1.00 and the Contractor is taking no corrective action, or
- b. When the Pay Factor (PF) for any constituent of a lot in progress drops below 0.95 and the Contractor is taking no corrective action, or
- c. When either the PF_i for any constituent or the CPF of a lot in progress is less than 0.75.

5-04.3(11)D4 An Entire Lot

An entire lot with a CPF of less than 0.75 will be rejected. The designated percentage reduction as defined in Section 1-06.2(2)B under Financial Incentive Paragraph 1, Item 3, shall be 25-percent.

5-04.3(12) Joints**5-04.3(12)A Transverse Joints**

The Contractor shall conduct operations such that the placing of the top or wearing course is a continuous operation or as close to continuous as possible. Unscheduled transverse joints will be allowed and the roller may pass over the unprotected end of the freshly laid mixture only when the placement of the course must be discontinued for such a length of time that the mixture will cool below compaction temperature. When the Work is resumed, the previously compacted mixture shall be cut back to produce a slightly beveled edge for the full thickness of the course.

A temporary wedge of HMA constructed on a 50H:1V shall be constructed where a transverse joint as a result of paving or planning is open to traffic. The HMA in the temporary wedge shall be separated from the permanent HMA by strips of heavy wrapping paper or other methods approved by the Engineer. The wrapping paper shall be removed and the joint trimmed to a slightly beveled edge for the full thickness of the course prior to resumption of paving.

The material that is cut away shall be wasted and new mix shall be laid against the cut. Rollers or tamping irons shall be used to seal the joint.

5-04.3(12)B Longitudinal Joints

The longitudinal joint in any one course shall be offset from the course immediately below by not more than 6-inches nor less than 2-inches. All longitudinal joints constructed in the wearing course shall be located at a lane line or an edge line of the Traveled Way.

On one-lane ramps a longitudinal joint may be constructed at the center of the traffic lane, subject to approval by the Project Engineer, if:

1. The ramp must remain open to traffic, or
2. The ramp is closed to traffic and a hot-lap joint is constructed.
 - a. If a hot-lap joint is allowed at the center of the traffic lane, two paving machines shall be used; a minimum compacted density in accordance with Section 5-04.3(10)B shall be achieved throughout the traffic lane; and construction equipment other than rollers shall not operate on any uncompacted mix.

When HMA is placed adjacent to cement concrete pavement, the Contractor shall construct longitudinal joints between the HMA and the cement concrete pavement. The joint shall be sawed to the dimensions shown on Standard Plan A-40.10-00 and filled with joint sealant meeting the requirements of Section 9-04.2.

5-04.3(13) Surface Smoothness

The completed surface of all courses shall be of uniform texture, smooth, uniform as to crown and grade, and free from defects of all kinds. The completed surface of the wearing course shall not vary more than $\frac{1}{8}$ -inch from the lower edge of a 10-foot straightedge placed on the surface parallel to the centerline. The transverse slope of the completed surface of the wearing course shall vary not more than $\frac{1}{4}$ -inch in 10-feet from the rate of transverse slope shown in the Plans.

When deviations in excess of the above tolerances are found that result from a high place in the HMA, the pavement surface shall be corrected by one of the following methods:

1. Removal of material from high places by grinding with an approved grinding machine, or
2. Removal and replacement of the wearing course of HMA, or
3. By other method approved by the Project Engineer.

Correction of defects shall be carried out until there are no deviations anywhere greater than the allowable tolerances.

Deviations in excess of the above tolerances that result from a low place in the HMA and deviations resulting from a high place where corrective action, in the opinion of the Project Engineer, will not produce satisfactory results will be accepted with a price adjustment. The Project Engineer shall deduct from monies due or that may become due to the Contractor the sum of \$500.00 for each and every section of single traffic lane 100-feet in length in which any excessive deviations described above are found.

When Portland cement concrete pavement is to be placed on HMA, the surface tolerance of the HMA shall be such that no surface elevation lies above the Plan grade minus the specified Plan depth of Portland cement concrete pavement. Prior to placing the Portland cement concrete pavement, any such irregularities shall be brought to the required tolerance by grinding or other means approved by the Project Engineer.

When utility appurtenances such as manhole covers and valve boxes are located in the Traveled Way, the Roadway shall be paved before the utility appurtenances are adjusted to the finished grade.

5-04.3(14) Planing Bituminous Pavement

Planing shall be performed in such a manner that the underlying pavement is not torn, broken, or otherwise damaged by the planing operation. Delamination or raveling of the underlying pavement will not be construed as damage due to the Contractor's operations. Pavement outside the limits shown in the Plans or designated by the Engineer that is damaged by the Contractor's operations shall be repaired to the satisfaction of the Engineer, at the Contractor's expense.

For mainline planing operations, the equipment shall have automatic controls, with sensors for either or both sides of the equipment. The controls shall be capable of sensing the grade from an outside reference line, or a mat-referencing device. The automatic controls shall have a transverse slope controller capable of maintaining the mandrel at the desired transverse slope (expressed as a percentage) within plus or minus 0.1-percent.

The planings and other debris resulting from the planing operation shall become the property of the Contractor and be disposed of in accordance with Section 2-03.3(7)C. The planings may be utilized as RAP, within the requirements of Section 5-04.2 or 9-03.21.

5-04.3(15) HMA Road Approaches

HMA approaches shall be constructed at the locations shown in the Plans or where staked by the Project Engineer. The Work shall be performed in accordance with Section 5-04.

5-04.3(16) Weather Limitations

HMA for wearing course shall not be placed on any Traveled Way beginning October 1st through March 31st of the following year without written approval from the Project Engineer.

Asphalt for prime coat shall not be applied when the ground temperature is lower than 50°F without written approval of the Project Engineer.

HMA shall not be placed on any wet surface, or when the average surface temperatures are less than those specified in the following table, or when weather conditions otherwise prevent the proper handling or finishing of the bituminous mixtures:

Surface Temperature Limitation		
Compacted Thickness (Feet)	Wearing Course	Other Courses
Less than 0.10	55°F	45°F
0.10 to 0.20	45°F	35°F
More than 0.20	35°F	35°F

5-04.3(17) Paving Under Traffic

When the Roadway being paved is open to traffic, the requirements of this section shall apply.

The Contractor shall keep on-ramps and off-ramps open to traffic at all times except when paving the ramp or paving across the ramp. During such time, and provided that there has been an advance warning to the public, the ramp may be closed for the minimum time required to place and compact the mixture. In hot weather, the Project Engineer may require the application of water to the pavement to accelerate the finish rolling of the pavement and to shorten the time required before reopening to traffic.

Before closing a ramp, advance warning signs shall be placed and signs shall also be placed marking the detour or alternate route. Ramps shall not be closed on consecutive interchanges at the same time.

During paving operations, temporary pavement markings shall be maintained throughout the project. Temporary pavement markings shall be installed on the Roadway prior to opening to traffic. Temporary pavement markings shall be in accordance with Section 8-23.

All costs in connection with performing the Work in accordance with these requirements, except the cost of temporary pavement markings, shall be included in the unit Contract prices for the various Bid items involved in the Contract.

5-04.3(18) Vacant

5-04.3(19) Sealing of Pavement Surfaces

Where shown in the Plans, the Contractor shall apply a fog seal. The fog seal shall be constructed in accordance with Section 5-02.3. Unless otherwise approved by the Project Engineer, the fog seal shall be applied prior to opening to traffic.

5-04.3(20) Anti-Stripping Additive

When directed by the Project Engineer, an anti-stripping additive shall be added to the HMA in accordance with Section 9-02.4.

5-04.3(21) Vacant

5-04.4 Measurement

HMA Cl. ____ PG ____, HMA for ____ Cl. ____ PG ____, and Commercial HMA will be measured by the ton in accordance with Section 1-09.2, with no deduction being made for the weight of asphalt binder, blending sand, mineral filler, or any other component of the mixture. If the Contractor elects to remove and replace mix as allowed by Section 5-04.3(11), the material removed will not be measured.

Preparation of untreated roadway will be measured by the mile once along the centerline of the main line Roadway. No additional measurement will be made for ramps, Auxiliary Lanes, service roads, Frontage Roads, or Shoulders. Measurement will be to the nearest 0.01-mile.

No specific unit of measure will apply to the force account item of crack sealing.

Soil residual herbicide will be measured by the mile for the stated width to the nearest 0.01-mile or by the square yard, whichever is designated in the Proposal.

Pavement repair excavation will be measured by the square yard of surface marked prior to excavation.

Asphalt for prime coat will be measured by the ton in accordance with Section 1-09.2.

Prime coat aggregate will be measured by the cubic yard, truck measure, or by the ton, whichever is designated in the Proposal.

Asphalt for fog seal will be measured by the ton, as provided in Section 5-02.4.

Longitudinal joint seals between the HMA and cement concrete pavement will be measured by the linear foot along the line and slope of the completed joint seal.

Planing bituminous pavement will be measured by the square yard.

Temporary pavement marking will be measured by the linear foot as provided in Section 8-23.4.

Removing temporary pavement marking will be measured by the linear foot as provided in Section 8-23.4.

Water will be measured by the M gallon as provided in Section 2-07.4.

No specific unit of measure will apply to the calculated item of anti-stripping additive.

No specific unit of measure will apply to the calculated item of job mix compliance price adjustment.

No specific unit of measure will apply to the calculated item of compaction price adjustment.

No specific unit of measure will apply to the calculated item of cyclic density price adjustment.

No specific unit of measure will apply to the calculated item of longitudinal joint density price adjustment.

5-04.5 Payment

Payment will be made in accordance with Section 1-04.1, for each of the following Bid items that are included in the Proposal:

“HMA Cl. ____ PG ____”, per ton.

“HMA for Approach Cl. ____ PG ____”, per ton.

“HMA for Preleveling Cl. ____ PG ____”, per ton.

“HMA for Pavement Repair Cl. ____ PG ____”, per ton.

“Commercial HMA”, per ton.

The unit Contract price per ton for “HMA Cl. ____ PG ____”, “HMA for Approach Cl. ____ PG ____”, “HMA for Preleveling Cl. ____ PG ____”, “HMA for Pavement Repair Cl. ____ PG ____”, and “Commercial HMA” shall be full compensation for all costs incurred to carry out the requirements of Section 5-04 except for those costs included in other items which are included in this sub-section and which are included in the Proposal.

“Preparation of Untreated Roadway”, per mile.

The unit Contract price per mile for “Preparation of Untreated Roadway” shall be full pay for all Work described under Section 5-04.3(5)B, with the exception, however, that all costs involved in patching the Roadway prior to placement of HMA shall be included in the unit Contract price per ton for “HMA Cl. ____ PG ____” which was used for patching. If the Proposal does not include a Bid item for “Preparation of Untreated Roadway”, the Roadway shall be prepared as specified, but the Work shall be included in the Contract prices of the other items of Work.

“Crack Sealing”, by force account.

“Crack Sealing” will be paid for by force account as specified in Section 1-09.6. For the purpose of providing a common Proposal for all Bidders, the Contracting Agency has entered an amount in the Proposal to become a part of the total Bid by the Contractor.

“Soil Residual Herbicide ____ ft. Wide,” per mile, or

“Soil Residual Herbicide”, per square yard.

The unit Contract price per mile or per square yard for “Soil Residual Herbicide” shall be full payment for all costs incurred to obtain, provide and install herbicide in accordance with Section 5-04.3(5)D.

“Pavement Repair Excavation Incl. Haul”, per square yard.

The unit Contract price per square yard for “Pavement Repair Excavation Incl. Haul” shall be full payment for all costs incurred to perform the Work described in Section 5-04.3(5)E with the exception, however, that all costs involved in the placement of HMA shall be included in the unit Contract price per ton for “HMA for Pavement Repair Cl. ____ PG ____”, per ton.

“Asphalt for Prime Coat”, per ton.

The unit Contract price per ton for “Asphalt for Prime Coat” shall be full payment for all costs incurred to obtain, provide and install the material in accordance with Section 5-04.3(5)B.

“Prime Coat Agg.”, per cubic yard, or per ton.

The unit Contract price per cubic yard or per ton for “Prime Coat Agg.” shall be full pay for furnishing, loading, and hauling aggregate to the place of deposit and spreading the aggregate in the quantities required by the Engineer.

“Asphalt for Fog Seal”, per ton.

Payment for “Asphalt for Fog Seal” is described in Section 5-02.5.

“Longitudinal Joint Seal”, per linear foot.

The unit Contract price per linear foot for “Longitudinal Joint Seal” shall be full payment for all costs incurred to perform the Work described in Section 5-04.3(12).

“Planing Bituminous Pavement”, per square yard.

The unit Contract price per square yard for “Planing Bituminous Pavement” shall be full payment for all costs incurred to perform the Work described in Section 5-04.3(14).

“Temporary Pavement Marking”, per linear foot.

Payment for “Temporary Pavement Marking” is described in Section 8-23.5.

“Removing Temporary Pavement Marking”, per linear foot.

Payment for “Removing Temporary Pavement Marking” is described in Section 8-23.5.

“Water”, per M gallon.

Payment for “Water” is described in Section 2-07.5.

“Anti-Stripping Additive”, by calculation.

“Anti-Stripping Additive” will be paid for in accordance with Section 1-09.6 except that no overhead, profit or other costs shall be allowed. Payment shall be made only for the invoice cost of the additive. The quantity of asphalt binder shall not be reduced by the quantity of anti-stripping additive used. For the purpose of providing a common Proposal for all Bidders, the Contracting Agency has entered an amount in the Proposal to become a part of the total Bid by the Contractor.

“Job Mix Compliance Price Adjustment,” by calculation.

“Job Mix Compliance Price Adjustment” will be calculated and paid for as described in Section 5-04.5(1).

“Compaction Price Adjustment,” by calculation.

“Compaction Price Adjustment” will be calculated and paid for as described in Section 5-04.5(1).

“Cyclic Density Price Adjustment,” by calculation.

“Cyclic Density Price Adjustment” will be calculated and paid for as described in Section 5-04.3(10)B item 1A.

“Longitudinal Joint Density Price Adjustment” by calculation.

“Longitudinal Joint Density Price Adjustment” will be calculated and paid for as described in Section 5-04.3(10)B.

5-04.5(1) Quality Assurance Price Adjustments

All HMA will be subject to price adjustments. Price adjustments for HMA mixture will be based on the requirements of 5-04.3(8). Price adjustments for HMA compaction will be based on the requirements in 5-04.3(10). For the purpose of providing a common Proposal for all Bidders, the Contracting Agency has estimated a calculated amount for all price adjustment items and has entered these amounts in the Proposal to become a part of the total Bid by the Contractor. Statistical analysis of the HMA will be performed in accordance with Section 1-06.2.

5-04.5(1)A Price Adjustments for Quality of HMA Mixture

Statistical analysis of quality of gradation and asphalt content will use the following price adjustment factors:

Table of Price Adjustment Factors	
Constituent	Factor “f”
All aggregate passing: 1½", 1", ¾", ½", ⅜" and No.4 sieves	2
All aggregate passing No. 8 sieve	15
All aggregate passing No. 200 sieve	20
Asphalt binder	40
Air Voids (Va)	20

A pay factor will be calculated for each sieve listed that is equal to or smaller than the maximum allowable aggregate size (100-percent passing sieve) asphalt binder and percent air voids (Va).

- Statistical Evaluation.** For each lot of HMA produced under Statistical Evaluation, a Job Mix Compliance Incentive Factor (JMCIF) will be determined. The JMCIF equals the algebraic difference of CPF minus 1.00 multiplied by 60-percent. The Job Mix Compliance Price Adjustment will be calculated as the product of the JMCIF, the quantity of HMA in the lot in tons, and the unit Contract price per ton of mix.
- Nonstatistical Evaluation.** Each lot of HMA produced under Nonstatistical Evaluation and having all constituents falling within the tolerance limits of the job mix formula shall be accepted at the unit Contract price with no further evaluation. When one or more constituents fall outside the nonstatistical tolerance limits in Section 9-03.8(7), the lot shall be evaluated in accordance with Section 1-06.2 to determine the appropriate CPF. The nonstatistical tolerance limits will be used in the calculation of the CPF and the maximum CPF shall be 1.00. When less than three sublots exist, backup samples of the existing sublots or samples from the Roadway shall be tested to provide a minimum of three sets of results for evaluation.

3. **Commercial Evaluation.** If sampled and tested, HMA produced under Commercial Evaluation and having all constituents falling within the tolerance limits of the job mix formula shall be accepted at the unit Contract price with no further evaluation. When one or more constituents fall outside the commercial tolerance limits in Section 9-03.8(7), the lot shall be evaluated in accordance with Section 1-06.2 to determine the appropriate CPF. The commercial tolerance limits will be used in the calculation of the CPF and the maximum CPF shall be 1.00. When less than three sublots exist, backup samples of the existing sublots or samples from the street shall be tested to provide a minimum of three sets of results for evaluation.

For each lot of HMA produced under Nonstatistical or Commercial Evaluation when the calculated CPF is less than 1.00, a Nonconforming Mix Factor (NCMF) will be determined. The NCMF equals the algebraic difference of CPF minus 1.00 multiplied by 60-percent. The Job Mix Compliance Price Adjustment will be calculated as the product of the NCMF, the quantity of HMA in the lot in tons, and the unit Contract price per ton of mix.

If a constituent is not measured in accordance with these Specifications, its individual pay factor will be considered 1.00 in calculating the Composite Pay Factor (CPF).

5-04.5(1)B Price Adjustments for Quality of HMA Compaction

For each compaction control lot with one or two sublots, having all sublots attain a relative density that is 91.0-percent of the reference maximum density the HMA shall be accepted at the unit Contract price with no further evaluation. When a subplot does not attain a relative density that is 91.0-percent of the reference maximum density, the lot shall be evaluated in accordance with Section 1-06.2 to determine the appropriate CPF. Additional testing by either a nuclear moisture-density gauge or cores will be completed as required to provide a minimum of three tests for evaluation.

For each compaction control lot with three or more sublots, a Compaction Incentive Price Adjustment Factor (CIPAF) will be determined. The CIPAF equals the algebraic difference of the CPF minus 1.00 multiplied by 40-percent. The Compaction Price Adjustment will be calculated as the product of CIPAF, the quantity of HMA in the compaction control lot in tons, and the unit Contract price per ton of mix.

5-05 CEMENT CONCRETE PAVEMENT

5-05.1 Description

This Work shall consist of constructing a pavement composed of Portland cement concrete on a prepared Subgrade or base in accordance with these Specifications and in conformity with the lines, grades, thicknesses, and typical cross-sections shown in the Plans or established by the Engineer.

5-05.2 Materials

Materials shall meet the requirements of the following sections:

Portland Cement	9-01
Fine Aggregate	9-03
Coarse Aggregate	9-03
Combined Aggregate	9-03
Joint Filler	9-04.1
Joint Sealants	9-04.2
Corrosion Resistant Dowel Bars	9-07.5(2)
Tie Bars	9-07.6
Concrete Patching Material	9-20
Curing Materials and Admixtures	9-23
Water	9-25
Epoxy Resins	9-26

5-05.3 Construction Requirements

5-05.3(1) Concrete Mix Design for Paving

The Contractor shall provide a concrete mix design for each design of concrete specified in the Contract. The Contractor shall use ACI 211.1 as a guide to determine proportions. Concrete strength, placement, and workability shall be the responsibility of the Contractor. Following approval of the Contractor's proposal, all other requirements of Section 5-05 shall apply.

1. **Materials.** Materials shall conform to Section 5-05.2. Fine aggregate shall conform to Section 9-03.1(2), Class 1. Coarse aggregate shall conform to Section 9-03.1(4), AASHTO grading No. 467. An alternate combined gradation conforming to Section 9-03.1(5) may be proposed, that has a nominal maximum aggregate size equal to or greater than a 1½-inch sieve.

Fly ash, if used, shall not exceed 35-percent by weight of the total cementitious material, shall conform to Section 9-23.9 and shall be limited to Class F with a maximum CaO content of 15-percent by weight.

Ground granulated blast furnace slag, if used, shall not exceed 25-percent by weight of the total cementitious material and shall conform to Section 9-23.10. When both ground granulated blast furnace slag and fly ash are included in the concrete mix, the total weight of both these materials is limited to 35-percent by weight of the total cementitious material. As an alternative to the use of fly ash, ground granulated blast furnace slag and cement as separate components, a blended hydraulic cement that meets the requirements of Section 9-01.2(4) Blended Hydraulic Cements may be used.

The water/cement ratio shall be calculated on the total weight of cementitious material. The following are considered cementitious materials: Portland cement, fly ash, ground granulated blast furnace slag and microsilica. The minimum cementitious material for any mix design shall be 564-pounds per cubic yard.

2. **Submittals.** The Contractor's submittal shall include the mix proportions per cubic yard, test results from beams and cylinders, and the proposed sources for all ingredients including the fly ash. The mix shall be capable of providing a minimum flexural strength of 650-psi at 14-days. Evaluation of strength shall be based on statistically analyzed results of 5 beam specimens made according to WSDOT T 808 and tested according to WSDOT T 802 that demonstrate a quality level of not less than 80-percent analyzed in accordance with Section 1-06.2(2)D. In addition the Contractor shall fabricate, cure, and test 5 sets of cylinders, for evaluation of 28-day strengths, according to WSDOT FOP's for AASHTO T 22 and AASHTO T 23 using the same mix design as used in fabrication of the beams.

Mix designs submitted by the Contractor shall provide a unique identification for each proposal and shall include test data confirming that concrete made in accordance with the proposed design will meet the requirements of these Specifications and the 28-day compressive strength result. Test data shall be from an independent testing lab or from a commercial concrete producer's lab. If the test data is developed at a producer's lab, the Engineer or a representative may witness all testing.

3. **Conformance to Mix Design.** Cement and coarse and fine aggregate weights shall be within the following tolerances of the mix design:

Portland Cement Concrete Batch Volumes		
Cement	+5%	-1%
Coarse Aggregate	+ 200-Pounds	- 200-Pounds
Fine Aggregate	+ 200-Pounds	- 200-Pounds

If the total cementitious material weight is made up of different components, these component weights shall be within the following tolerances:

- a. Portland cement weight plus 5-percent or minus 1-percent of that specified in the mix design.
- b. Fly ash and ground granulated blast furnace slag weight plus or minus 5-percent of that specified in the mix design.
- c. Microsilica weight plus or minus 10-percent of that specified in the mix design.

Water shall not exceed the maximum water specified in the mix design.

The Contractor may initiate minor adjustments to the approved mix proportions within the tolerances noted above without resubmitting the mix design.

Utilizing admixtures to accelerate the set or to increase workability will be permitted only when approved by the Engineer. Only nonchloride accelerating admixtures that meet the requirements of Section 9-23.6, Admixture for Concrete, shall be used.

The Contractor shall notify the Engineer in writing of any proposed modification. A new mix design will designate a new lot.

5-05.3(2) Consistency

The materials shall be mixed with sufficient water to produce a stiff concrete which will hold its shape when deposited upon the Subgrade. Concrete placed during wet weather must be mixed with sufficient water to produce a very stiff mixture. The consistency shall be such that separation of the mortar from the coarse aggregate will not occur in handling.

The water/cementitious material ratio, by weight, shall not exceed 0.44. When slip form paving equipment is used, the Contractor shall further control concrete consistency to ensure that edge slump conforms to the requirements of Section 5-05.3(11).

5-05.3(3) Equipment

Equipment necessary for handling materials and performing all parts of the Work shall conform to the following requirements:

5-05.3(3)A Batching Plant and Equipment

1. **General.** The batching plant shall include bins, weighing hoppers, and scales for the fine aggregate and for each size of coarse aggregate. If cement is used in bulk, a bin, hopper, and separate scale for cement shall be included. The weighing hoppers shall be properly sealed and vented to preclude dusting during operation. The batching plant shall be equipped with a suitable batch counter that cannot be reset, which will correctly indicate the number of batches proportioned.
2. **Bins and Hoppers.** Bins with adequate separate compartments for fine aggregate and for each size of the coarse aggregate shall be provided in the batching plant.

5-05.3(3)B Mixing Equipment

1. **General.** Concrete may be mixed at a batching plant or wholly or in part in truck mixers. Each mixer shall have attached in a prominent place a manufacturer's plate showing the capacity of the drum in terms of volume of mixed concrete and the speed of rotation of the mixing drum or blades.
2. **Batching Plant.** Mixing shall be in an approved mixer capable of combining the aggregates, cement, and water into a thoroughly mixed and uniform weight within the specified mixing period.
Mixers shall be cleaned at suitable intervals. The pickup and throw-over blades in the drum shall be repaired or replaced when they are worn down $\frac{3}{4}$ -inch or more. The Contractor shall have available at the jobsite a copy of the manufacturer's design, showing dimensions and arrangements of the blades in reference to original height and depth, or provide permanent marks on blades to show points of $\frac{3}{4}$ -inch wear from new conditions. Drilled holes $\frac{1}{4}$ -inch in diameter near each end and at midpoint of each blade are recommended.
3. **Truck Mixers and Truck Agitators.** Truck mixers used for mixing and hauling concrete, and truck agitators used for hauling plant-mixed concrete, shall conform to the requirements of Section 6-02.3(4)A.
4. **Nonagitator Trucks.** Bodies of nonagitating hauling equipment for concrete shall be smooth, mortar-tight, metal containers and shall be capable of discharging the concrete at a satisfactory controlled rate without segregation. Covers shall be provided when needed for protection. Plant-mixed concrete may be transported in nonagitated vehicles provided that the concrete is delivered to the site of the Work and discharge is completed within 45-minutes after the introduction of mixing water to the cement and aggregates, and provided the concrete is in a workable condition when placed.

5-05.3(3)C Finishing Equipment

The standard method of constructing concrete pavement on State Highways shall be with approved slip-form paving equipment designed to spread, consolidate, screed, and float-finish the freshly placed concrete in one complete pass of the machine so a dense and homogeneous pavement is achieved with a minimum of hand finishing. On other roads and on WSDOT projects requiring less than 1,000-square yards of cement

concrete pavement or requiring individual placement areas of less than 1,000-square yards, irregular areas, intersections, and at locations inaccessible to slip-form paving equipment, cement concrete pavement may be placed with approved placement and finishing equipment utilizing stationary side forms. Hand screeding and float finishing of cement concrete pavement may only be utilized on small irregular areas as allowed by the Engineer.

5-05.3(3)D Joint Sawing Equipment

The Contractor shall provide approved power driven concrete saws for sawing joints, adequate in number of units and power to complete the sawing at the required rate. The Contractor shall provide at least one standby saw in good working order. An ample supply of saw blades shall be maintained at the site of the Work at all times during sawing operations. The Contractor shall provide adequate artificial lighting facilities for night sawing. All of this equipment shall be on the job both before and continuously during concrete placement. Sawing equipment shall be available immediately and continuously upon call by the Engineer on a 24-hour basis, including Saturdays, Sundays and holidays.

5-05.3(3)E Smoothness Testing Equipment

The Contractor shall provide a California-type computerized profilograph, complete with recorder, for determining the profile index of the pavement according to WSDOT Test Method No. 807. The profilograph shall be on the project, calibrated, in good working condition, and ready for operation before construction of any concrete pavement begins. The operator shall be competent and experienced in operation of the equipment.

5-05.3(4) Measuring, and Batching Materials

The batch plant site, layout, equipment, and provisions for transporting material shall ensure a continuous supply of material to the Work.

1. Measuring Materials

- a. **Aggregates.** The fine aggregate and each size of coarse aggregate shall be measured by weighing, the weight for the particular aggregates used being proportional to their respective bulk specific gravities. The weighing of each size of material shall be a separate and distinct operation.

Corrections shall be made for variations in weight of materials due to the moisture content.

The equipment for weighing aggregates shall conform to the requirements of Section 1-09.2.

- b. **Cement.** Cement shall be weighed on scales meeting the requirements of Section 1-09.2. Adequate provision shall be made to prevent loss of cement between the batch box and the mixer.
- c. **Water.** Water may be measured either by volume or by weight. The accuracy of measuring the water shall be within a range of error of not over 1-percent.

2. **Batching Materials.** On all projects requiring more than 2500-cubic yards of Portland cement concrete for paving, the batching plant shall be equipped to proportion aggregates and cement by weight by means of automatic and interlocked proportioning devices of approved type.

5-05.3(4)A Acceptance of Portland Cement Concrete Pavement

Acceptance of Portland cement concrete pavement shall be as provided under statistical or nonstatistical acceptance. Determination of statistical or nonstatistical shall be based on Proposal quantities and shall consider the total of all Bid items involving of a specific class.

Statistical acceptance will apply only to Contracts advertised, Awarded and administered by WSDOT, unless specifically provided otherwise in the Special Provisions. Contracting agencies other than WSDOT must specifically invoke statistical acceptance in their Special Provisions if it is desired.

Statistical Acceptance, (1) applies only to WSDOT projects, (2) is administered under the provisions of Section 5-05.5, and (3) will be used for a class of mix when the Proposal quantities for that class of mix is 1500-cubic yards or greater.

Nonstatistical Acceptance will be used (1) for a class of mix when the Proposal quantities for that class of mix is less than 1500-cubic yards and (2) all contracts advertised, Awarded and administered by agencies other than WSDOT.

The point of acceptance will be per WAQTC FOP for TM 2 or at the point of discharge when a pump is used.

Acceptance of Concrete. The concrete producer shall provide a certificate of compliance for each truckload of concrete in accordance with Section 6-02.3(5)B.

For the purpose of acceptance sampling and testing, a lot is defined as having a maximum of 15 sublots that was produced for the same class of mix. The final lot may be increased to 25 sublots. All of the test results obtained from the same lot shall be evaluated collectively. The quantity represented by each sample will constitute a subplot. Sampling and testing shall be performed on a random basis at the frequency of one sample per subplot. Sublot size shall be determined to the nearest 10-cubic yards to provide not less than three uniform sized sublots with a maximum subplot size of 500-cubic yards.

Acceptance testing for compliance of air content and 28-day compressive strength shall be conducted from samples prepared according to WAQTC FOP TM 2. Air content shall be determined by conducting WAQTC FOP for AASHTO T 152. Compressive Strength shall be determined by AASHTO T 23 and AASHTO T 22.

The Contractor shall provide cure boxes in accordance with Section 6-02.3(5)H, and protect concrete cylinders in cure boxes from excessive vibration and shock waves during the curing period in accordance with Section 6-02.3(6)D. Payment for cure boxes shall be in accordance with Section 6-02.5.

Rejection of Concrete

1. **Rejection by the Contractor.** The Contractor may, prior to sampling, elect to remove any defective material and replace it with new material at no expense to the Contracting Agency. Any such new material will be sampled, tested, and evaluated for acceptance.
2. **Rejection Without Testing.** The Engineer may reject any load that appears defective prior to placement. Material rejected before placement shall not be incorporated into the pavement. No payment will be made for the rejected materials unless the Contractor requests that the rejected material be tested. If the Contractor elects to have the rejected materials tested, a sample will be taken and both the air content and strength shall be tested by WSDOT.

Payment for rejected material will be based on the results of the one sample, which was taken and tested. If the rejected material fails either test, no payment will be made for the rejected material; in addition, the cost of sampling and testing at the rate of \$250.00 per sample shall be borne by the Contractor. If the rejected material passes both tests, the mix will be compensated at a CPF of 1.00 and the cost of the sampling and testing will borne by the Contracting Agency.

Statistical Acceptance

The results of all acceptance testing performed in the field and the Composite Pay Factor (CPF) of the lot after three sublots have been tested will be available to the contractor through WSDOT's website.

The Specification limits as defined in Section 1-06.2(2)D shall be as follows. The lower Specification limit for Air Content shall be 3-percent, and the upper Specification limit for Air Content shall be 7-percent. The lower Specification limit for compressive strength shall be 1200-psi less than that established in the mix design as the arithmetic mean of the 5 sets of 28-day compressive strength cylinders, or 3000-psi, whichever is higher. These compressive strength cylinders are to be cast at the same time as the flexural beams that were used to prequalify the mix design under Section 5-05.3(1). There is no upper Specification limit for 28-day compressive strength.

The price adjustment factor (f_i) defined in Section 1-06.2(2)D shall be 6 for compressive strength and 4 for air content.

If either the air content or compressive strength is not measured in accordance with this section its individual pay factor will be considered to be 1.00 in calculating the Composite Pay Factor.

Non-Statistical Acceptance

Concrete will be accepted based on conformance to the requirement for air content and the compressive strength at 28-days for sublots as tested and determined by the Contracting Agency. The lower Specification limit for air content shall be 3-percent, and the upper Specification limit for air content shall be 7-percent. The lower Specification limit for compressive strength shall be 1,200-psi less than that established in the mix design as the arithmetic mean of the five sets of 28-day compressive strength cylinders, or 3,000-psi, whichever is higher. These compressive strength cylinders are to be cast at the same time as the flexural beams that were used to prequalify the mix design under Section 5-05.3(1).

Each subplot will be deemed to have met the specified compressive strength requirement when both of the following conditions are met:

1. Individual strength tests do not fall below the lower specification limit for strength by more than 12½-percent, or 500-psi, whichever is least.
2. An individual strength test averaged with the two preceding individual strength tests meets or exceeds the lower specification limit for strength.

When compressive strengths fail to satisfy one or both of the above requirements, the Contractor may request acceptance of in-place concrete strength based on core results. This method will not be used if the Engineer determines coring would be harmful to the integrity of the Structure. Cores, if allowed, will be obtained by the Contractor in accordance with AASHTO T 24 and delivered to the Contracting Agency for testing in accordance with AASHTO T 22. If the concrete in the Structure will be dry under service conditions, the core will be air-dried at a temperature of between 60°F and 80°F and at a relative humidity of less than 60-percent for 7-days before testing, and will be tested air dry.

Acceptance for each subplot by the core method requires that the average compressive strength of three cores be at least 85-percent of the specified strength with no one core less than 75-percent of the specified strength. When the Contractor requests strength analysis by coring, the results obtained will be accepted by both parties as conclusive and supersede all other strength data for the concrete subplot.

If the Contractor elects to core, cores shall be obtained no later than 50-days after initial concrete placement. The Engineer will concur in the locations to be cored. Repair of cored areas shall be the responsibility of the Contractor. The cost incurred in coring and testing these cores, including repair of core locations, shall be borne by the Contractor.

5-05.3(5) Mixing Concrete

The concrete may be mixed in a batching plant or in truck mixers. The mixer shall be of an approved type and capacity. Mixing time shall be measured from the time all materials are in the drum. Ready-mixed concrete shall be mixed and delivered in accordance with the requirements of Section 6-02.3(4), 6-02.3(4)A and 6-02.3(4)B.

When mixed in a batching plant, the mixing time shall not be less than 50-seconds nor more than 90-seconds.

The mixer shall be operated at a drum speed as shown on the manufacturer's nameplate on the mixer. Any concrete mixed less than the specified time shall be discarded and disposed of by the Contractor at no expense to the Contracting Agency. The volume of concrete mixed per batch shall not exceed the mixer's rated capacity, as shown on the manufacturer's standard rating plate on the mixer.

Each concrete mixing machine shall be equipped with a device for counting automatically the number of batches mixed during the day's operation.

Retempering concrete by adding water or by other means will not be permitted.

5-05.3(5)A Limitations of Mixing

Concrete shall not be mixed, placed, or finished when the natural light is inadequate, as determined by the Engineer, unless an adequate and approved artificial lighting system is operated.

Mixing and placing concrete shall be discontinued when a descending air temperature in the shade away from artificial heat reaches 40°F and shall not be resumed until an ascending air temperature in the shade and away from artificial heat reaches 35°F unless authorized in writing by the Engineer.

When mixing and placing is authorized during cold weather, the aggregates may be heated by either steam or dry heat prior to being placed in the mixer. The apparatus used shall heat the mass uniformly and shall be arranged to preclude the possible occurrence of overheated areas which might injure the materials. Unless otherwise authorized, the temperature of the mixed concrete shall be not less than 50°F and not more than 90°F at the time of discharge into the hauling conveyance. No concrete shall be mixed with frozen aggregates.

5-05.3(6) Subgrade

The Subgrade shall be constructed in accordance with Section 2-06.

The Subgrade shall be prepared and compacted a minimum of 3-feet beyond each edge of the area which is to receive concrete pavement in order to accommodate the slip-form equipment. Concrete shall not be placed on a frozen Subgrade nor during heavy rainfall.

The Subgrade shall be moist before the concrete is placed.

When the Subgrade is an asphalt treated base the surface shall be clean and free of any deleterious materials. When placing concrete on a treated base, the surface temperature shall not exceed 90°F. If water is used for cooling any excess water standing in pools or flowing on the surface shall be removed prior to placing concrete.

5-05.3(7) Placing, Spreading, and Compacting Concrete

The provisions relating to the frequency and amplitude of internal vibration shall be considered the minimum requirements and are intended to ensure adequate density in the hardened concrete. Referee testing of hardened concrete will be performed by cutting cores from the finished pavement after a minimum of 24-hours of curing. Density

determination will be made based on the water content of the core as taken. WSDOT Test Method T 810 shall be used for the determination of core density. Reference cores will be taken at the minimum rate of 1 for each 500-cubic yards of pavement, or fraction thereof. These same cores will be used for thickness measurements as required by Section 5-05.5(1).

The average density of the cores shall be at least 97-percent of the approved mix design density or the actual concrete density when determined by the Contractor using AASHTO T 121 with no cores having a density of less than 96-percent.

Failure to meet the above requirement will be considered as evidence that the minimum requirements for vibration are inadequate for the job conditions, and additional vibrating units or other means of increasing the effect of vibration shall be employed so that the density of the hardened concrete as indicated by further referee testing shall conform to the above listed requirements. Primary units of pavement, as defined in Section 5-05.5(1), not meeting the prescribed minimum density shall be removed and replaced with satisfactory material. At the option of the Engineer, noncompliant material may be accepted at a reduced price.

5-05.3(7)A Slip-Form Construction

The concrete shall be distributed uniformly into final position by a self-propelled slip-form paver without delay. The alignment and elevation of the paver shall be regulated from outside reference lines established for this purpose. The paver shall vibrate the concrete for the full width and depth of the strip of pavement being placed and the vibration shall be adequate to provide a consistency of concrete that will stand normal to the surface with sharp well-defined edges. The sliding forms shall be rigidly held together laterally to prevent spreading of the forms.

The plastic concrete shall be effectively consolidated by internal vibration with transverse vibrating units for the full width of pavement and/or a series of equally spaced longitudinal vibrating units. The space from the outer edge of the pavement to the outer longitudinal unit shall not exceed 9-inches. The spacing of internal units shall be uniform and not exceed 18-inches.

The term internal vibration means vibration by vibrating units located within the specified thickness of pavement section.

The rate of vibration of each vibrating unit shall be not less than 7,500-cycles per minute, and the amplitude of vibration shall be sufficient to be perceptible on the surface of the concrete along the entire length of the vibrating unit and for a distance of at least 1-foot. The frequency of vibration or amplitude shall be varied proportionately with the rate of travel to result in a uniform density and air content. The paving machine shall be equipped with a tachometer or other suitable device for measuring and indicating the actual frequency of vibrations.

The concrete shall be held at a uniform consistency. The slip-form paver shall be operated with as nearly a continuous forward movement as possible and all operations of mixing, delivering, and spreading concrete shall be coordinated to provide uniform progress with stopping and starting of the paver held to a minimum. If, for any reason, it is necessary to stop the forward movement of the paver, the vibratory and tamping elements shall also be stopped immediately. No tractive force shall be applied to the machine, except that which is controlled from the machine.

When concrete is being placed adjacent to an existing pavement, that part of the equipment which is supported on the existing pavement shall be equipped with protective pads on crawler tracks or rubber-tired wheels on which the bearing surface is offset to run a sufficient distance from the edge of the pavement to avoid breaking the pavement edge.

5-05.3(7)B Stationary Side Form Construction

Side form sections shall be straight, free from warps, bends, indentations, or other defects. Defective forms shall be removed from the Work. Metal side forms shall be used unless other forms are approved by the Project Engineer.

Side forms may be built up by rigidly attaching a section to either top or bottom of forms. If such buildup is attached to the top of metal forms, the buildup shall be of metal.

Side forms shall be of sufficient rigidity, both in the form and in the interlocking connection with adjoining forms, that springing will not occur under the weight of grading and paving equipment or from the pressure of concrete. The Contractor shall provide sufficient forms so that there will be no delay in placing the concrete due to lack of forms.

Before placing side forms, the underlying material shall be at the proper grade. Side forms shall be placed to the required grade and alignment of the edge of the finished pavement. Wood wedges may be used to adjust the form elevation provided they do not extend into the concrete. The forms shall be firmly supported during the entire operation of placing, compacting, and finishing the pavement.

Forms shall be drilled in advance of being placed to line and grade to accommodate tie bars where these are specified.

Immediately in advance of placing concrete and after all Subgrade operations are completed, side forms shall be trued and maintained to the required line and grade for a distance sufficient to prevent delay in placing concrete.

Side forms shall remain in place at least 12-hours after the concrete has been placed, and in all cases until the edge of the pavement no longer requires the protection of the forms. Curing compound shall be applied to the concrete immediately after the forms are removed.

Side forms shall be thoroughly cleaned and oiled each time they are used and before concrete is placed against them.

Concrete shall be spread, screeded, shaped, and consolidated by one or more self-propelled machines. These machines shall uniformly distribute and consolidate concrete without segregation so that completed pavement will conform to required cross section with a minimum of handwork.

The number and capacity of machines furnished shall be adequate to perform the Work required at a rate equal to that of concrete delivery.

Concrete for the full paving width shall be effectively consolidated by means of surface vibrators, in combination with internal vibrators, or by some other method of consolidation that produces equivalent results without segregation.

When vibrators are used to consolidate concrete, the rate of vibration shall be not less than 3,500-cycles per minute for surface vibrators and shall be not less than 7,000-cycles per minute for internal vibrators. Amplitude of vibration shall be sufficient to be perceptible on the surface of the concrete more than 1-foot from the vibrating element. The Contractor shall furnish a tachometer or other suitable device for measuring and indicating frequency of vibration.

Power to vibrators shall be connected so that vibration ceases when forward or backward motion of the machine is stopped.

5-05.3(8) Joints

Joints in cement concrete pavement will be designated as longitudinal and transverse contraction joints, longitudinal and transverse construction joints, or isolation joints, and shall be constructed as shown in the Plans and in accordance with the following provisions:

All contraction joints shall be constructed at the locations, intervals, and depths shown in the Standard Plan. The faces of all joints shall be constructed perpendicular to the surface of the cement concrete pavement.

5-05.3(8)A Contraction Joints

All transverse and longitudinal contraction joints shall be formed with suitable power-driven concrete saws. The Contractor shall provide sufficient sawing equipment capable of completing the sawing to the required dimensions and at the required rate to control cracking. The Contractor shall provide adequate artificial lighting facilities for night sawing. Joints shall not vary from the specified or indicated line by more than $\frac{3}{4}$ -inch.

Commencement of sawing transverse contraction joints will be dependent upon the setting time of the concrete and shall be done at the earliest possible time following placement of the concrete without tearing or raveling the adjacent concrete excessively.

Longitudinal contraction joints shall be sawed as required to control cracking and as soon as practical after the initial control transverse contraction joints are completed.

Any damage to the curing material during the sawing operations shall be repaired immediately after the sawing is completed.

When cement concrete pavement is placed adjacent to existing cement concrete pavement, the vertical face of all existing working joints shall be covered with a bond-breaking material such as polyethylene film, roofing paper, or other material as approved by the Engineer.

5-05.3(8)B Sealing Sawed Contraction Joints

Sawed contraction joints shall be filled with a joint sealant filler conforming to the requirements of Section 9-04.2. Joints shall be thoroughly clean at the time of sealing and if the hot-poured type is used the joints shall be dry. Care shall be taken to avoid air pockets. The hot-poured compound shall be applied in two or more layers, if necessary. The hot-poured compound and the cold-poured compound shall be applied under sufficient pressure to fill the groove from bottom to top and the cured joint sealant shall be between $\frac{1}{4}$ -inch and $\frac{5}{8}$ -inch below the top surface of the concrete. The joint filled with cold-poured compound shall then be covered with a strip of nonabsorbent paper at least twice as wide as the joint and the paper shall be left in place.

5-05.3(8)C Construction Joints

When placing of concrete is discontinued for more than 45-minutes, a transverse construction joint shall be installed. Construction joints shall be as shown in the Standard Plan.

Transverse construction joints shall be constructed between cement concrete pavement and reinforced concrete bridge approach slabs.

All transverse and longitudinal construction joints, including the joint between new and existing pavement when widened, shall be sawed and sealed with joint filler conforming to the requirements of Sections 5-05.3(8)A and 9-04.2.

5-05.3(8)D Isolation Joints

Premolded joint filler in accordance with Section 9-04.1(2) shall be placed as detailed in the Plans through the full depth of concrete pavement when drainage features are placed within the concrete pavement.

5-05.3(9) Vacant

5-05.3(10) Tie Bars and Corrosion Resistant Dowel Bars

Tie bars shall be placed at all longitudinal contraction and construction joints, in accordance with the requirements shown in the Standard Plan. In addition, tie bars shall be installed when concrete Shoulders are placed as a separate operation or when widening existing pavement.

Tie bars shall be placed at longitudinal construction joints between lanes in a manner that the individual bars are located at the required elevation and spaced as shown in the Standard Plan and in a manner that the vertical edge of the concrete is not deformed or otherwise damaged during placement of the bars.

Placement tolerances for tie bars shall be within 1-inch of the middle of the concrete slab, within 1-inch of being centered over the joint and placed parallel or perpendicular to centerline within 1-inch of the vertical and horizontal plane.

Corrosion resistant dowel bars will be required for the construction joint at the end of paving operations each day and they shall be placed in accordance with the Standard Plan. Corrosion resistant dowel bars shall be placed at all transverse contraction joints as shown in the Contract or in accordance with the Standard Plans. All dowel bars shall have a parting compound, such as curing compound, grease or other Engineer approved equal applied to them prior to placement. Any dowel bar delivered to the project that displays rust/oxidation, pinholes, questionable blemishes, or deviates from the round shall be rejected.

The Contractor shall furnish a Manufacturer's Certificate of Compliance in accordance with Section 1-0.6.3, including mill test report verifying conformance to the requirements of Section 9-07.5(2) as well as written certification identifying the patching material, when applicable, used at cut dowel bar ends.

Only one type of corrosion resistant dowel bars will be allowed per contract; intermixing of different corrosion resistant dowel bar types will not be allowed.

Placement tolerances for dowel bars shall be within 1-inch of the middle of the concrete slab, within 1-inch of being centered over the transverse joint and parallel to centerline within ½-inch of the vertical and the horizontal plane.

Cutting of stiffeners within the dowel bar cage is not allowed.

When fresh concrete pavement is to be placed against pre-project existing cement concrete pavement, tie bars shall be drilled and set into the existing pavement with an epoxy bonding agent in accordance with the Standard Plan and specified tolerances for placement of tie bars. The epoxy-bonding agent shall be either Type I or IV epoxy resin as specified in Section 9-26. The Contractor may use any method for drilling the holes, provided the method selected does not damage the existing concrete. Any damage caused by the Contractor's operations shall be repaired by the Contractor at no cost to the Contracting Agency in accordance with Section 1-07.13.

The tie bar holes shall be blown clean with compressed air before grouting. The bar shall be centered in the hole for the full length of embedment before grouting. The grout shall then be pumped into the hole around the bar in a manner that the back of the hole will be filled first. Blocking or shimming shall not impede the flow of the grout into the hole. Dams, if needed, shall be placed at the front of the holes to confine the grout. The dams shall permit the escape of air without leaking grout and shall not be removed until grout has cured in the hole.

5-05.3(11) Finishing

After the concrete has been given a preliminary finish by means of finishing devices incorporated in the slip-form paving equipment, the surface of the fresh concrete shall be checked by the Contractor with a straightedge device not less than 10-feet in length. High areas indicated by the straightedge device shall be removed by the hand-float method. Each successive check with the straightedge device shall lap the previous check path by

at least $\frac{1}{2}$ of the length of the straightedge. The requirements of this paragraph may be waived if it is successfully demonstrated that other means will consistently produce a surface with a satisfactory profile index and meeting the 10-foot straightedge requirement specified in Section 5-05.3(12).

Any edge slump of the pavement, exclusive of specified edging, in excess of $\frac{1}{4}$ -inch shall be corrected before the concrete has hardened. If edge slump on any 1-foot or greater length of hardened concrete exceeds 1-inch, the concrete shall be repaired as provided in Section 5-05.3(22).

The pavement shall be given a final finish surface by texturing with a comb perpendicular to the centerline of the pavement. The comb shall produce striations approximately $\frac{1}{8}$ -inch to $\frac{3}{16}$ -inch in depth. Randomly space the striations from $\frac{1}{2}$ -inch to $1\frac{1}{4}$ -inch. The comb shall be operated mechanically either singly or in gangs with several placed end to end. Finishing shall take place with the elements of the comb as nearly perpendicular to the concrete surface as is practical, to eliminate dragging the mortar. If the striation equipment has not been previously approved, a test section shall be constructed prior to approval of the equipment. If the pavement has a raised curb without a formed concrete gutter, the texturing shall end 2-feet from the curb line.

At the beginning and end of paving each day, the Contractor shall, with an approved stamp, indent the concrete surface near the right hand edge of the panel to indicate the date, month, and year of placement.

At approximate 500-foot intervals where designated by the Engineer the Contractor shall, with an approved stamp, indent the concrete surface near the right hand edge of the pavement with the stationing of the Roadway.

5-05.3(12) Surface Smoothness

The pavement smoothness will be checked with equipment furnished and operated by the Contractor, under supervision of the Engineer, within 48-hours following placement of concrete. Smoothness of all pavement placed except Shoulders, ramp tapers, intersections and small or irregular areas as defined by Section 5-05.3(3) unless specified otherwise, will be measured with a recording profilograph, as specified in Section 5-05.3(3), parallel to centerline, from which the profile index will be determined in accordance with WSDOT Test Method 807.

For the purpose of qualifying the equipment and methods used by the Contractor, a daily profile index will be computed. For pavement placed in a 12-foot width or less, the daily profile index will be the average of two profiles made approximately 3-feet from and parallel to each edge of the pavement. If the pavement is placed in a width greater than 12-feet, the daily profile index will be computed as the average of profiles made approximately 3-feet from and parallel to each edge and at the approximate location of each planned longitudinal joint.

The daily profile index of the finished pavement thus determined will be 7-inches per mile, or less. Only equipment and methods that consistently produce a finished surface meeting this requirement shall be used. Should the daily profile index exceed the rate of 7-inches per mile, the paving operations shall be discontinued until other methods or equipment are provided by the Contractor. Such revised methods and equipment shall again be discontinued if they do not produce a finished surface having a daily profile index of 7-inches per mile, or less. Operations shall not be resumed until the Engineer approves further changes in methods and equipment as proposed by the Contractor.

All areas representing high points having deviations in excess of 0.3-inch as determined by procedures described in WSDOT Test Method 807, shall be reduced by abrasive methods until such deviations do not exceed 0.1-inch as determined by reruns of the profilograph. High areas of individual profiles shall be reduced by abrasive means so that the profile index will not exceed 0.7-inch in any 0.1-mile section. All high areas in excess of 0.1-inch shall be reduced to 0.0-inch prior to reducing any high points of

0.1-inch or less. Low spots exceeding .25-inch shall be corrected in a manner approved by the Engineer.

When any of the daily profile indexes exceed 7-inches per mile, final acceptance of the pavement for smoothness parallel to the centerline will be based on profile indexes as measured with the profilograph, operating by the Contractor under the supervision of the Engineer, along a line parallel to the edge of pavement and each longitudinal joint and will not be averaged for acceptance purposes. The final acceptance profile indexes will be measured after all corrective Work is complete and will demonstrate that all 0.1-mile sections on the project are within the 0.7-inch Specification.

When cement concrete pavement abuts bridges, the finished pavement parallel to centerline within 15-feet of the abutting joint shall be uniform to a degree that no variations greater than $\frac{1}{8}$ -inch are present when tested with a 10-foot straightedge.

When paving intersections, small or irregular areas, as defined in Section 5-05.3(3), surface smoothness will be measured with a 10-foot straightedge no later than 5:00 p.m. of the day following the placing of the concrete. A 10-foot straightedge will be placed parallel to the centerline so as to bridge any depressions and touch all high spots. Should the surface vary more than $\frac{1}{8}$ -inch from the lower edge of the straightedge, the high portion shall be reduced by the Contractor to the $\frac{1}{8}$ -inch tolerance by abrasive means at no expense to the Contracting Agency. It is further provided that if reduction of high portions of the surface involves breaking, dislodging, or other disturbance of the aggregates, such cutting will not be permitted until the pavement has achieved its design strength. If in the opinion of the Engineer irregularities cannot be satisfactorily removed by such methods, the Contractor shall remove and replace the pavement at no expense to the Contracting Agency.

Smoothness perpendicular to the centerline will be measured with a 10-foot straight edge across all lanes with the same cross slope, including shoulders when composed of cement concrete pavement. The overlapping 10-foot straight edge measurement shall be discontinued at a point 6-inches from the most extreme outside edge of the finished cement concrete pavement. The transverse slope of the finished pavement shall be uniform to a degree such that no variations greater than $\frac{1}{4}$ -inch are present when tested with a 10-foot long straightedge laid in a direction perpendicular to the centerline. Any areas that are in excess of this specified tolerance shall be corrected by abrasive means.

5-05.3(13) Curing

Immediately after the finishing operations have been completed and as soon as marring of the concrete will not occur, the entire surface of the newly placed concrete shall be cured in accordance with one of the following methods the Contractor may elect.

5-05.3(13)A Curing Compound

Liquid membrane-forming concrete curing compound Type 2 meeting the requirements of Section 9-23.2 shall be applied to the entire area of the exposed surface of the concrete with an approved mechanical spray machine. The spray fog shall be protected from the wind with an adequate shield. It shall be applied uniformly at the rate of one gallon to not more than 150-square feet.

The compound shall be applied with equipment of the pressure tank or pump type equipped with a feed tank agitator which ensures continuous agitation of the compound during spraying operations. The nozzle shall be of the two-line type with sufficient air to properly atomize the compound.

The curing compound shall not be applied during or immediately after rainfall. If it becomes necessary to leave the pavement uncoated overnight, it shall be covered with polyethylene sheeting, which shall remain in place until weather conditions are favorable for the application of the curing compound.

In the event that rain falls on the newly coated pavement before the film has dried sufficiently to resist damage, or in the event of damage to the film from any cause, the Contractor shall apply a new coat of curing compound in one or two applications to the affected area at the rate which, in the opinion of the Engineer, will result in a film of curing value equal to that specified in the original coat.

Before placing the curing compound in the spray tank, it shall be thoroughly agitated as recommended by the Manufacturer. The compound shall not be diluted by the addition of solvents nor be altered in any manner. If the compound has become chilled to the extent that it is too viscous for proper stirring or application or if portions of the vehicle have been precipitated from solution, it shall be heated to restore proper fluidity but it shall not be heated above 100°F. All curing compound shall have approval prior to placing in the spray tanks.

The curing compound shall be applied immediately after the concrete has been finished and after any bleed water that has collected on the surface has disappeared, or at a time designated by the Engineer. If hair checking develops in the pavement before finishing is completed, the Engineer may order the application of the curing compound at an earlier stage, in which event any concrete cut from the surface in finishing operations shall be removed entirely from the pavement. If additional mortar is then needed to fill torn areas, it shall be obtained ahead of the spraying operations. All areas cut by finishing tools subsequent to the application of the curing compound shall immediately be given new applications at the rate specified above.

The curing compound, after application, shall be protected by the Contractor from injury until the pavement has reached a minimum compressive strength of 2500-psi. All traffic, either by foot or otherwise, shall be considered as injurious to the film of the applied compound.

The Contractor shall provide on the job a sufficient quantity of white polyethylene sheeting to cover all the pavement laid in 3-hours of maximum operation. This sheeting shall be reserved exclusively for the protection of the pavement in case of rain or breakdown of the spray equipment used for applying the curing compound. The protective sheeting shall be placed over the pavement when ordered, and in the manner specified by the Engineer.

Areas from which it is impossible to exclude traffic shall be protected by a covering of sand or earth not less than 1-foot in thickness or by other suitable and effective means. The protective covering shall be placed no earlier than 24-hours after application of the compound.

All liquid membrane-forming curing compounds shall be removed from the Portland cement concrete pavement to which traffic delineators are to be bonded. Curing compound removal shall not be started until the pavement has attained sufficient flexural strength for traffic to be allowed on it. The Contractor shall submit a proposed removal method to the Engineer and shall not begin the removal process until the Engineer has approved the removal method.

The Contractor shall assume all liabilities for and protect the Contracting Agency from any damages or claims arising from the use of materials or processes described herein.

5-05.3(13)B White Polyethylene Sheeting

The sheeting shall be placed over the pavement immediately after finishing operations are completed, or at a time designated by the Engineer.

The sheeting shall be laid so that individual sheets overlap at least 2-feet, and the lapped areas shall be held in close contact with the pavement by weighting with earth or boards to prevent movement by the wind. The sheeting shall extend downward to cover the edges of the pavement and shall be secured to the Subgrade with a continuous bank of earth or surfacing material. Any holes occurring in the sheeting shall be patched

immediately to the satisfaction of the Engineer. The sheeting shall be maintained against injury and remain in place until the pavement has reached a minimum compressive strength of 2500-psi.

5-05.3(13)C Wet Curing

Wet curing shall be accomplished by applying a continuous fog or mist spray to the entire pavement surface until it has reached a minimum compressive strength of 2500-psi. If water runoff is not a concern, continuous sprinkling is acceptable. Sprinkling shall not begin until the concrete has achieved initial set as determined by AASHTO T 197 or other approved method.

5-05.3(14) Cold Weather Work

When the air temperature is expected to reach the freezing point during the day or night and the pavement has not reached 50-percent of its design strength or 2500-psi which ever is greater the concrete shall be protected from freezing. The Contractor shall, at no expense to the Contracting Agency, provide a sufficient supply of straw, hay, grass, earth, blankets, or other suitable blanketing material and spread it over the pavement to a sufficient depth to prevent freezing of the concrete. The Contractor shall be responsible for the quality and strength of the concrete thus cured. Any concrete injured by frost action or freezing shall be removed and replaced at the Contractor's expense in accordance with these Specifications.

5-05.3(15) Concrete Pavement Construction in Adjacent Lanes

Unless otherwise shown in the Plans or in the Special Provisions, the pavement shall be constructed in multiple lanes; that is, 2 or more adjacent lanes paved in a single operation. Longitudinal contraction joints shall be used between adjacent lanes that are paved concurrently, and construction joints shall be used when lanes are paved separately. Tie bars shall be installed during initial lane construction.

The Contractor shall replace, at no expense to the Contracting Agency, any panels on the new pavement that are cracked or broken as a result of the Contractor's operations.

5-05.3(16) Protection of Pavement

The Contractor shall protect the pavement and its appurtenances from any damage. Protection shall include personnel to direct traffic and the erection and maintenance of warning signs, lights, barricades, temporary take-down bridges across the pavement with adequate approaches, and whatever other means may be necessary to accommodate local traffic and to protect the pavement during the curing period or until opened to traffic as determined by the Engineer.

The operation of construction equipment on the new pavement will not be allowed until the pavement has developed a compressive strength of 2500-psi as determined from cylinders, made at the time of placement, cured under comparable conditions, and tested in accordance with AASHTO T 22. Exceptions would be one track from a slip form-paving machine when paving adjacent lanes or light vehicles required for sawing operations or taking cores.

Placement of Shoulder material may commence when the pavement has developed a compressive strength of 1800-psi as determined from cylinders made at the time of placement, cured under comparable conditions, and tested in accordance with AASHTO T 22 as long as construction equipment is not operated on the new pavement.

A continuous barrier of the design shown in the Plans shall be constructed and maintained along the edge of the pavement being constructed and adjacent to the portion of the Roadway used for traffic. The barriers shall be left in place until the new pavement is ready to be opened to traffic and shall then be removed by the Contractor.

Any damage to the pavement occurring prior to final acceptance shall be replaced or repaired in accordance with Section 5-05.3(22).

5-05.3(17) Opening to Traffic

The pavement may be opened to traffic when the concrete has developed a compressive strength of 2500-psi as determined from cylinders, made at the time of placement, cured under comparable conditions, and tested in accordance with AASHTO T 22.

Fabrication, curing, and testing of cylinders to measure early strength shall be the responsibility of the Contractor. The Contractor shall obtain the services of an independent Laboratory to perform these activities and these laboratories shall be approved by the Engineer. At the Contractor's option, the time for opening pavement may be determined through the use of the maturity test in accordance with ASTM C 1074. The Contractor shall develop the maturity-strength relationship and provide maturity curves along with supporting data for approval by the Engineer. The Contractor shall furnish all equipment, including thermal or maturity meter, thermocouples, wire, and qualified personnel to monitor maturity and provide information to the Engineer. Field procedures to monitor maturity shall be submitted to the Engineer for approval prior to use. The pavement shall not be opened to traffic until the maturity-strength relationship shows the pavement has a compressive strength of 2500-psi and approved by the Engineer.

The pavement shall be cleaned prior to opening to traffic.

All costs associated with early-strength cylinders shall be at the Contractor's expense.

5-05.3(18) Vacant**5-05.3(19) Vacant****5-05.3(20) Vacant****5-05.3(21) Vacant****5-05.3(22) Repair of Defective Pavement Slabs**

Broken slabs, slabs with random cracks, nonworking contraction joints near cracks, edge slumping and spalls along joints and cracks shall be replaced or repaired as specified at no expense to the Contracting Agency, and shall be accomplished prior to completion of joint sealing.

Pavement slabs containing more than one crack shall be entirely removed and replaced. Pavement slabs containing a single crack shall be removed and replaced such that the minimum dimension of the removed slab is 6-feet long and full panel width. The portion of the panel to remain in place shall have a minimum dimension of 6-feet in length and full panel width, otherwise entire removal and replacement of the slab is required. There shall be no new joints closer than 3-feet to an existing transverse joints. Saw cutting full pavement depth is required along all longitudinal joints and at transverse locations. Tie bars and dowel bars shall be used in accordance Section 5-05.3(10).

Spalls and edge slumping shall be repaired by making vertical saw cuts at least 3-inches outside the affected area and to a minimum depth of 2-inches. Spall repairs that encounter dowel bars or are within 6-inches of a dowel bar will not be permitted. These spall areas shall be repaired by replacing a half or full panel as permitted by the Engineer. Removal of the existing pavement shall not damage any pavement to be left in place. If jackhammers are used for removing pavement, they shall not weigh more than 30-pounds, and chipping hammers shall not weigh more than 15-pounds. All power-driven hand tools used for the removal of pavement shall be operated at angles less than 45-degrees as measured from the surface of the pavement to the tool. The patch limits shall extend beyond the spalled area a minimum of 3-inches. Repair areas shall be kept square or rectangular. Repair areas that are within 12-inches of another repair area shall be combined.

The Contractor shall remove material within the perimeter of the saw cut to a depth of 2-inches, or to sound concrete as determined by the Engineer. The surface patch area shall be sandblasted and all loose material removed. All sandblasting residue shall be removed using dry oil-free air.

When a partial depth repair is placed directly against an adjacent longitudinal joint, a bond-breaking material such as polyethylene film, roofing paper, or other material as approved by the Engineer shall be placed between the existing concrete and the area to be patched.

Patches that abut working transverse joints or cracks require placement of a compressible insert. The new joint or crack shall be formed to the same width as the existing joint or crack. The compressible joint material shall be placed into the existing joint 1-inch below the depth of repair. The compressible insert shall extend at least 3-inches beyond each end of the patch boundaries.

Patches that abut the lane/shoulder joint require placement of a formed edge, along the slab edge, even with the surface.

The patching material shall be mixed, placed, consolidated, finished, and cured according to manufacturer's recommendations. Slab/patch interfaces that will not receive pavement grinding shall be sealed (painted) with a 1:1 cement-water grout along the patch perimeter.

The Contractor shall reseal all joints in accordance with Section 5-05.3(8)B.

Opening to traffic shall meet the requirements of Section 5-05.3(17).

Low areas which grinding cannot feasibly remedy, shall be sandblasted, filled with epoxy bonded mortar, and textured by grinding. The epoxy bonding agent shall meet the requirements of Section 9-26.1(1)B for Type II epoxy.

5-05.4 Measurement

Cement concrete pavement will be measured by the cubic yard for the completed pavement. The volume will be determined from measurements taken as listed below.

1. The width measurement will be the width of the pavement shown on the typical cross-section in the Plans, additional widening where called for, or as otherwise specified in writing by the Engineer.
2. The length will be measured along the center of each Roadway or ramp.
3. The depth will be determined from the reference cores. The depth utilized to calculate the volume shall not exceed the Plan depth plus 0.04-feet.

The volume of the pavement section represented by the reference core shall equal the measured length \times width \times reference core depth.

Corrosion resistant dowel bar will be measured per each for the actual number of bars used in the completed Work.

Tie bar with drill hole will be measured per each for the actual number of bars used in the completed Work.

The ride smoothness compliance adjustment calculation is the volume of pavement, in cubic yards, represented by the profilograph.

The calculation for Portland cement concrete compliance adjustment is the volume of concrete represented by the CPF and the Thickness deficiency adjustment.

5-05.5 Payment

Payment will be made in accordance with Section 1-04.1, for each of the following Bid items that are included in the Proposal:

“Cement Conc. Pavement”, per cubic yard.

The unit Contract price per cubic yard for “Cement Conc. Pavement” shall be full compensation for all costs incurred to carry out the requirements of Section 5-05, except for those costs included in other items, which are included in this subsection and are included in the Proposal.

“Corrosion Resistant Dowel Bar”, per each,

The unit Contract price per each for “Corrosion Resistant Dowel Bar” shall be full payment for furnishing, and installing corrosion resistant dowel bars and any costs for drilling holes, placing dowel bars with baskets, furnishing and installing parting compound and all other costs associated with completing the installation of corrosion resistant dowel bars.

“Tie Bar with Drill Hole”, per each.

The unit Contract price per each, “Tie Bar with Drill Hole” shall be full payment for furnishing, and installing tie bars and any costs for drilling holes, and all other costs associated with installation of tie bars

“Ride Smoothness Compliance Adjustment”, by calculation.

Payment for “Ride Smoothness Compliance Adjustment” will be calculated by multiplying the unit Contract price for cement concrete pavement, times the volume for adjustment, times the percent of adjustment determined from the schedule below.

1. Adjustment will be based on the initial profile index before corrective Work.
2. “Ride Smoothness Compliance Adjustment” will be calculated for each 0.1-mile section represented by profilogram using the following schedule:

Ride Smoothness Profile Index (Inches per mile)	Compliance Adjustment (Percent adjustment)
1.0 or less	+4
over 1.0 to 2.0	+3
over 2.0 to 3.0	+2
over 3.0 to 4.0	+1
over 4.0 to 7.0	0
over 7.0	-2*

*Also requires correction to 7-inches per mile.

“Portland Cement Concrete Compliance Adjustment”, by calculation.

Payment for “Portland Cement Concrete Compliance Adjustment” will be calculated by multiplying the unit Contract price for the cement concrete pavement, times the volume for adjustment, times the percent of adjustment determined from the calculated CPF and the Deficiency Adjustment listed in Section 5-05.5(1)A.

5-05.5(1) Pavement Thickness

Cement concrete pavement shall be constructed in accordance with the thickness requirements in the Plans and Specifications. Tolerances allowed for Subgrade construction and other provisions, which may affect thickness, shall not be construed to modify such thickness requirements.

A primary unit of pavement is defined as the area of pavement placed in each day's paving operations or a complete intersection. Within such primary unit of pavement, there may be an area or areas, which are deficient in thickness by more than 0.05-foot. This deficient area or areas will be defined as a secondary unit or units. If secondary units are found to exist, the primary unit area will be reduced by the secondary unit area included therein. At a time determined by the Engineer, thickness measurements will be made in each primary unit of pavement at the minimum rate of one measurement for each 500-cubic yards of pavement, or fraction thereof. The exact location and number of

thickness measurements within each primary unit, both longitudinally and transversely, will be determined by the Engineer. In general, thickness measurements will be made at uniform intervals throughout each primary unit of pavement.

If thickness deficiencies greater than 0.05-foot are found to exist, supplemental thickness measurements will be made in accordance with Section 5-05.5(1)B. Pavement thickness variations, if any, from the thickness requirements in the Plans and Specifications will be determined by comparing the actual thickness measurement with the thickness specified at the location where the measurement was made. Such variation will be determined to the nearest 0.01-foot as either excess or deficient thickness.

Additional cores may be requested by the Contractor to isolate the area that has a thickness deficiency within the 0.05-feet of the design thickness. These cores will be used to create a secondary unit. All costs for the additional cores including grouting the core holes will be the responsibility of the Contractor.

5-05.5(1)A Thickness Deficiency of 0.05-Foot or Less

If no thickness measurements in a primary unit are deficient by more than 0.05-foot, all thickness measurements in such unit will be averaged to the nearest 0.01-foot to determine the average thickness deficiency, if any, in that primary unit. For the purpose of determining the average thickness deficiency, an excess thickness variation of more than 0.04-foot will be considered to be 0.04-foot greater than the specified thickness.

For each primary unit of pavement which is deficient in average thickness by not more than 0.05-foot, the Contractor shall pay to the Contracting Agency, or the Contracting Agency may deduct from any moneys due or that may become due the Contractor under the Contract, a sum computed by multiplying the deficiency adjustment from the following table by the unit Contract price by the volume of such unit.

Average Thickness Deficiency (feet)	Deficiency Adjustment (per cubic yard)
0.01	2%
0.02	4%
0.03	9%
0.04	16%
0.05	25%

5-05.5(1)B Thickness Deficiency of More Than 0.05-Foot

Where a thickness deficiency greater than 0.05-foot is encountered, the Engineer will determine from supplemental thickness measurements the limits of the secondary unit area. Thickness measurements will be made in each panel of pavement adjacent transversely and longitudinally to the panel of the original measurement. This procedure will continue, regardless of unit boundaries, until such secondary unit area is bounded by panels with a thickness deficiency of 0.05-foot or less. Cores taken to isolate the secondary unit will not be used to compute average thickness of the primary unit.

Panels are the areas bounded by longitudinal and transverse joints and pavement edges. If longitudinal or transverse joints are eliminated by the Special Provisions, by the Plans, or for any other reasons, the limits of panels will be determined by the Engineer as if such joints had been constructed.

The secondary unit area will be made up of entire panels only. The entire panel will be considered to be of the thickness shown by measurement.

After the Engineer has determined the limits of the secondary unit area, a further determination will be made whether any panels within this area are usable and may be left in place. Following this determination, the Contractor shall remove and replace at no expense to the Contracting Agency such panels as the Engineer may designate in accordance with the following:

If the area to be removed is not bounded by longitudinal or transverse joints, the Contractor shall saw, at no expense to the Contracting Agency, weakened plane joints at the locations designated by the Engineer. The Subgrade shall be lowered to meet the full thickness requirements. The replaced pavement will be tested for thickness by means of additional measurements and will be subject to all of the requirements of the Specifications.

Usable panels may be removed and replaced as outlined above at the option of the Contractor, or these panels will be permitted to remain in place, provided that no payment will be made for any panels which are left in place, and that a further penalty will be assessed in the amount of 25-percent of the Contractor's unit Bid price for all such panels. The Contracting Agency may deduct such amount from any moneys due or that may become due the Contractor under the Contract.

The cost of all thickness measurements made to determine the secondary unit areas, including filling the core holes with concrete, will be deducted at the rate of \$150.00 per core from any moneys due or that may become due the Contractor under the Contract.

All additional Work required and any delay to the Contractor's operations as a result of this Specification shall not be cause for additional pay nor for an extension of time.

